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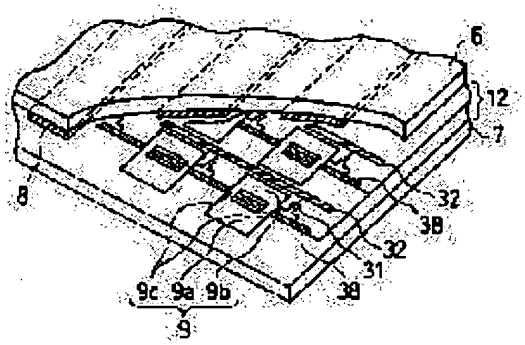
(54) LIQUID CRYSTAL DISPLAY DEVICE AND ITS PRODUCTION

(57)Abstract:

PROBLEM TO BE SOLVED: To decrease the shortening of respective pieces of wiring and disconnection defects and to improve the yield or production and dependence on visual angle by constituting the liquid crystal display device in such a manner that the three refractive indices of a refractive index ellipsoid of a phase difference plate have a specific relation, that this refractive index ellipsoid is tilted and that alignment layers have plural alignment regions in respective pixel regions corresponding to respective pixel electrodes.



SOLUTION: The pixel electrodes 9 are divided at an area ratio 17:3 to divided pixel parts 9a, 9b varying in liquid crystal alignment. Reference lines 38 pass in the spacings between these parts. As a result, the visual angle dependence of a specular visual angle direction may be improved. The three main refractive indices na, nb and nc of the refractive index ellipsoid at the phase difference plate have the relation na=nc>nb and one of the main refractive indices na, nc is parallel with the surface of the phase difference plate. The main refractive index nb is rotated to the state inclining from the state parallel to the normal direction of the surface of the phase difference plate around the direction of the paralleling main refractive indices, by which the refractive index ellipsoid is inclined. The alignment layers have the plural alignment regions subjected to

the alignment treatments respectively varying in the respective pixel regions corresponding to the respective pixel electrodes.

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CLAIMS

[Claim(s)]
[Claim 1] A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate It is the liquid crystal display characterized by having two or more orientation fields where orientation processing from which it differs in each pixel field corresponding to [the above-mentioned index ellipsoid inclines and] each above-mentioned pixel electrode in the above-mentioned orientation film, respectively was performed.
[Claim 2] The above-mentioned orientation film is a liquid crystal display according to claim 1 characterized by having the orientation field where a viewing angle becomes good to which above or down or an one direction, and the orientation field where a viewing angle becomes good to another direction of above or down in each above-mentioned pixel field.
[Claim 3] The liquid crystal display according to claim 1 characterized by being set up so that the direction where the liquid crystal molecule near the orientation film inclines in the orientation field of the largest area in each above-mentioned pixel field when an electrical potential difference is impressed to a pixel electrode, and the inclination direction of the above-mentioned index ellipsoid may become opposite.

[Claim 4] The above-mentioned scanning line is a liquid crystal display according to claim 1 characterized by arranging the boundary of the above-mentioned orientation fields in the location corresponding to wiring which consists of metals of protection-from-light nature, and consists of metals of the above-mentioned scanning line and/or protection-from-light nature.
[Claim 5] Two or more orientation fields where orientation processing different, respectively was performed in each above-mentioned pixel field are liquid crystal displays according to claim 4 characterized by being prepared only in the orientation film on the above-mentioned pixel substrate.
[Claim 6] A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines. The above-mentioned orientation film Are the manufacture approach of a liquid crystal display of having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode, and the above-mentioned orientation film is received. By irradiating light to the above-mentioned orientation film using rubbing down stream processing which performs orientation processing, and the pattern mask corresponding to each above-mentioned orientation field by rubbing processing The manufacture approach of the liquid crystal display characterized by having optical exposure down stream processing which performs orientation processing different, respectively to each orientation field.
[Claim 7] It is the manufacture approach of the liquid crystal display according to claim 6 which the above-mentioned orientation field is set up in [two] each above-mentioned pixel field, and is characterized by performing the above-mentioned optical exposure process only to one of the above-mentioned orientation fields.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display equipped with switching elements, such as a thin film transistor, and its manufacture approach.
[0002]
[Description of the Prior Art] Before, the liquid crystal display using the liquid crystal display component of a pneumatic mold is widely used for liquid crystal displays of a numerical segmental die, such as a clock and a calculator. Also in recently, taking advantage of the descriptions, such as a thin shape, a light weight, and a low power, the liquid crystal display was used as displays including a word processor, a computer, and a navigation system, and has expanded the commercial scene widely.
[0003] The liquid crystal display of the active-matrix mold which allotted the pixel in the shape of a matrix is widely used with the height of the display grace among the above-mentioned liquid crystal displays these days, using active elements, such as TFT (Thin Film Transistor), as a switching element.
[0004] since such a liquid crystal display has advantages, like that thickness (depth) is boiled markedly and can be made thin as compared with CRT (Cathode Ray Tube), that power consumption is small, and full-color-izing is easy, the need has spread in broad fields, such as a notebook computer, a monitor for games, pocket television, and a digital camera. However, since the conventional liquid crystal display is inferior in respect of dependability etc. an angle of visibility, brightness, color reproduction nature, and over a long period of time as compared with CRT and the manufacturing cost has also become about 15 times from 3 times of CRT, the various methods about a liquid crystal display are proposed from many companies or the research facilities of a university for the improvement.
[0005] As the liquid crystal display of the conventional transparency mold active-matrix mold has the active-matrix substrate of translucency and shows it to this active-matrix substrate at drawing 11 , two or more pixel electrode 51 -- for impressing an electrical potential difference to a liquid crystal layer is formed in the shape of a matrix. As an active element which is a switching means for carrying out the selection drive of this pixel electrode 51 --, thin film transistor (TFT is called hereafter) 52 -- is formed in the above-mentioned active-matrix substrate, and is connected to pixel electrode 51 --. Although not illustrated, in addition to the above-mentioned configuration, in the case where color display is furthermore performed, red and which green and blue color filter layer are prepared on the above-mentioned active-matrix substrate or the opposite substrate on the substrate.
[0006] Scanning-line 53 -- is connected to the gate electrode in above-mentioned TFT52 --, and signal-line 54 -- is connected to the source electrode, respectively. It is the pixel electrode 51 with which signal-line 54 -- was arranged in the shape of a matrix with above-mentioned scanning-line 53 --. -- It passes along a perimeter, and it is arranged so that it may intersect perpendicularly mutually. Drive control of TFT52 -- is carried out by inputting a gate signal through above-mentioned scanning-line 53 --. Moreover, above-mentioned signal-line 54 -- is minded, and it is TFT52. -- A data signal (status signal) is inputted into pixel electrode 51 -- through TFT52 -- at the time of a drive.
[0007] Furthermore, TFT52 -- Pixel electrode 51 -- and addition capacity 55-- are connected to the drain

electrode. The counterelectrode which counters through an insulating layer to this addition capacity 55 -- is connected to common wiring 56 --, respectively. Addition capacity 55 -- is for holding the electrical potential difference impressed to a liquid crystal layer.

[0008] In the liquid crystal display of a active-matrix mold, the liquid crystal layer is pinched between the above-mentioned active-matrix substrate and the opposite substrate which counters this. The thickness of this liquid crystal layer is set as about 4.5-5.3 micrometers on the average. That is, a liquid crystal layer will be pinched between pixel electrode 51 -- formed on the active-matrix substrate, and the counterelectrode currently formed on the opposite substrate, and will form liquid crystal capacity. Above-mentioned addition capacity 55 -- is connected so that it may become in parallel with the above-mentioned liquid crystal capacity.

[0009] As shown in drawing 12 , the gate electrode 62 is formed on the transparent insulating substrate 61, and if said TFT52 is explained in more detail, gate dielectric film 63 is formed so that this may be covered. The semi-conductor thin film 64 is formed in the upper part of the gate electrode 62 through gate dielectric film 63. The channel protective layer 65 is formed in the central upper part of this semi-conductor thin film 64. Source electrode 66a which is from a microcrystal n+-silicon layer on the source section side of this channel protective layer 65 and the semi-conductor thin film 64 is formed, and drain electrode 66b which consists of a microcrystal n+-silicon layer as well as a drain section side is formed.

[0010] Metal layer 67a which becomes source wiring to the above-mentioned source electrode 66a is connected, and metal layer 67b which becomes drain wiring to drain electrode 66b is connected. This front face of TFT52 is covered with the interlayer insulation film 68, and the transparence electric conduction film used as the pixel electrode 51 is further formed on it. The pixel electrode 51 is connected with metal layer 67b used as drain wiring of TFT52 through the contact hole 69. Moreover, although not illustrated, on the pixel electrode 51, the orientation film for carrying out orientation of the liquid crystal is formed all over the viewing area at about 1 appearance.

[0011] As the above-mentioned interlayer insulation film 68, inorganic thin films, such as SiN, are used conventionally. The above-mentioned SiN film is CVD (Chemical Vapor Deposition). It can form in about 300nm or more of thickness by using law.

[0012] The liquid crystal molecule used as the above-mentioned liquid crystal layer here has refractive-index anisotropy deltan, further, this liquid crystal molecule inclined to the active-matrix substrate and opposite substrate which are pinching the liquid crystal molecule, in order to carry out orientation, the contrast of a display image changed with the directions and include angles which an observer looks at, and the trouble that a viewing-angle dependency becomes large is produced.

[0013] The liquid crystal display method of the Twisted Nematic (it is hereafter described as TN) mold which may be in the liquid crystal display of a pneumatic mold, and is used about the above-mentioned trouble is explained. For example, if the electrical potential difference of a halftone display is impressed to the liquid crystal display component 71 of TN mold as shown in drawing 13 , the liquid crystal molecule 72 will be in the condition of having started a little. At this time, the include angles at which the linearly polarized light 75 which passes through the direction of a normal of 73-substrate 74 front face, and the linearly polarized light 76-77 passed with an inclination to the direction of a normal cross the liquid crystal molecule 72 will differ in this liquid crystal display component 71, respectively. Since refractive-index anisotropy deltan exists in the liquid crystal molecule 72 as mentioned above, if the linearly polarized light 75-76-77 of each above-mentioned direction passes the liquid crystal molecule 72, forward Tsunemitsu and abnormality light will occur. In connection with the phase contrast of these forward Tsunemitsu and abnormality light, the above-mentioned linearly polarized light 75-76-77 will be changed into elliptically polarized light, respectively, and this serves as a generation source of a viewing-angle dependency.

[0014] Furthermore, inside an actual liquid crystal layer, the liquid crystal molecule 72 is in the condition that tilt angles differ near near the pars intermedia of a substrate 73 and a substrate 74, the substrate 73, or the substrate 74, and 90 degrees of liquid crystal molecules 72 can be twisted centering on the direction of a normal. With the direction and include angle, the linearly polarized light 75-76-77 which passes a liquid crystal layer by the above thing will receive various birefringence effectiveness,

and will show a complicated viewing-angle dependency, respectively.
[0015] If the viewing angle is specifically leaned in the direction of a stigmatism angle which is down [of a screen] from the screen normal as the above-mentioned viewing-angle dependency as shown in drawing 14 , the phenomenon (henceforth a "coloring phenomenon") which a display image colors above a certain include angle, and the phenomenon (henceforth "reversal") which black and white reverse will occur. Moreover, if a viewing angle is leaned in the direction of a reverse-sight angle which is above [of a screen] and it goes to it, contrast will fall rapidly.
[0016] In addition, in the above-mentioned liquid crystal display, there is also a problem that an angle of visibility becomes narrow as the display screen becomes large. If a big liquid crystal display screen is seen from a transverse plane in a near distance, the colors displayed in the upper part and the lower part of a screen for the effect of a viewing-angle dependency may differ. This is because a chance [of seeing the whole screen] angle becomes large and it becomes the same thing as seeing a liquid crystal display screen from the direction of slanting more.
[0017] In order to improve such a viewing-angle dependency, inserting the phase contrast plate (phase contrast film) as an optical element which has an optical anisotropy between a liquid crystal display component and one polarizing plate is proposed (for example, reference, such as JP,55-600,A).
[0018] By passing the phase contrast plate which made the light changed into elliptically polarized light from the linearly polarized light as mentioned above placed between one side or the both sides of a liquid crystal layer, this approach compensates the phase contrast of the forward Tsunemitsu and abnormality light which are produced in a viewing angle, reconverts it in the light of the linearly polarized light, and enables an improvement of a viewing-angle dependency. However, by this approach, it is necessary to set up also about a property, not only a phase contrast plate but a liquid crystal layer, i.e., a liquid crystal display component, and, moreover, the improvement effect of sufficient viewing-angle dependency cannot be acquired.
[0019] Then, in order to improve a viewing-angle dependency more, the one direction of the principal indices of refraction in an index ellipsoid receives this using an parallel thing to the direction of a normal of the front face of the above-mentioned phase contrast plate as the above-mentioned phase contrast plate. What takes the configuration which has the value of retardation (retardation) deltan-d which is the product of refractive-index anisotropy deltan of a liquid crystal ingredient and thickness d of a liquid crystal layer as a liquid crystal display component in the range of 200 to 500nm is used. The liquid crystal display which makes the above-mentioned phase contrast plate intervene between this liquid crystal display component and polarizing plate is proposed (JP,5-313159,A).
[0020] This approach makes it possible it not only to set up the property of a phase contrast plate and a liquid crystal display component, but to take the configuration set up so that the direction of rubbing of the orientation film which forms a liquid crystal display component, the direction of a lagging axis of a phase contrast plate, and the transparency shaft orientation of a polarizing plate may be parallel, respectively, and to improve a viewing-angle dependency further by this. However, even when such a phase contrast plate is used, the reversal of the direction of a stigmatism angle is seen at a narrow include angle.
[0021] Furthermore, the approach using that toward which the direction of the principal indices of refraction of an index ellipsoid inclines to the direction of a normal of the front face of a phase contrast plate as the above-mentioned phase contrast plate is also proposed (JP,6-75116,A, JP,8-50206,A, etc.). By this approach, two kinds of things as follows are used as a phase contrast plate.
[0022] The direction of one of the minimum principal indices of refraction is parallel to a front face among the three principal indices of refraction of an index ellipsoid. And one direction of remaining two principal indices of refraction inclines at an angle of theta to the front face of a phase contrast plate, the direction of another side inclines at an angle of theta similarly to the direction of a normal of a phase contrast plate front face, and the value of this theta is the phase contrast plate which is filling 20 degrees <= theta<=70 degrees.
[0023] The principal indices of refraction [in / another does not have a refractive-index anisotropy into the front face of a phase contrast plate, and / the direction of a surface normal of a phase contrast plate]

nb, and the principal indices of refraction na parallel to the front face of a phase contrast plate, It is that in which nc fills the relation of na=nc>nb, namely, has optically uniaxial [negative]. The principal indices of refraction nb furthermore, by rotating a clockwise rotation or a counterclockwise rotation to the condition of having inclined from the condition parallel to the direction of a normal of a phase contrast plate front face centering on the above-mentioned phase contrast plate front face and one side of the principal indices of refraction na and nc which make parallel It is the phase contrast plate with which the above-mentioned index ellipsoid inclined.
[0024] About two kinds of above-mentioned phase contrast plates, the former can use an optically uniaxial thing and an optically biaxial thing, respectively. moreover, the principal indices of refraction [in / the latter not only uses one phase contrast plate, but sees these a set of two phase contrast plates, and / the direction of a normal of a phase contrast plate front face] nb -- what was set up so that each above-mentioned inclination direction might make the include angle of 90 degrees mutually can be used.

[0025] in the liquid crystal display constituted by making such at least one or more phase contrast plates intervene between a liquid crystal display component and a polarizing plate, the until improvement of the viewing-angle dependency can be carried out to some extent. As shown in drawing 15 as the example, compared with drawing 14 , contrast is improved mostly in an omnidirection, and reversal of the direction of a stigmatism angle is also improved to about 35 degrees.
[0026] Furthermore, the structure which forms in one pixel electrode field the field where a tilt angle differs from an orientation condition as an improvement means of another viewing-angle dependency is also proposed (JP,5-210099,A, JP,7-64096,A, etc.). according to this, a until viewing-angle dependency can be made to improve to some extent
[0027] Furthermore, the method called an IPS (In Plane Switching) method as a liquid crystal display of new structure is developed, and fertilization is progressing (the patent number No. 2701698 official report, the patent number No. 2701832 official report). This method impresses electric field almost in parallel with the field inboard of a liquid crystal display substrate, and they carry out image display by controlling the sense of the liquid crystal molecule of each pixel. In the liquid crystal display method with which the present utilization is progressing, a viewing-angle property can realize the best liquid crystal display, and this method is being put in practical use centering on monitors, such as a computer.
[0028] Moreover, the liquid crystal display of a configuration of having formed the signal line in the opposite substrate side is proposed as the liquid crystal display of a configuration of having been shown in drawing 11 and drawing 12 , and a liquid crystal display of a configuration of differing from the above-mentioned IPS method liquid crystal display (JP,5-27264,A, JP,7-128687,A, etc.). As this liquid crystal display is shown in drawing 16 , the liquid crystal layer 83 is formed in the gap of the pixel substrate 85 and the opposite substrate 84, TFT87 --, scanning-line 81--, pixel electrode 86--, and datum-line 88-- are formed on the pixel substrate 85, and signal-line 82 -- is formed on the opposite substrate 84. Thus, since it has the composition that signal-line 82 -- was formed on the respectively different substrate with scanning-line 81 --, possibility with signal-line 82 -- that a short circuit defect will arise in between becomes that there is nothing with scanning-line 81 --. Therefore, the yield can be improved.
[0029]
[Problem(s) to be Solved by the Invention] however, SiNX which is a transparence insulator layer as an interlayer insulation film 68 in the liquid crystal display of a configuration of having been shown in drawing 11 and drawing 12 , SiO2, and TaOX etc. -- when membranes are formed by the CVD method or the spatter, the irregularity on front faces, such as metal layer 67a and 67b used as a substrate, and the channel protective layer 65, will be reflected on an interlayer insulation film 68. For this reason, since a bigger level difference will be formed based on the level difference of various kinds of film used as a substrate when pixel electrode 51 -- is formed on an interlayer insulation film 68, the trouble of causing the poor orientation (disclination) of a liquid crystal molecule has been produced.
[0030] Moreover, it is the pixel electrode 51 arranged in the shape of a matrix on the transparence substrate 61 whose signal-line 54 -- is the same substrate with scanning-line 53 --. -- It passes along a

perimeter, and it is arranged so that many lines may cross mutually, respectively. Namely, the scanning line [-- The laminating will be carried out.] 53 -- Signal line 54 -- At each intersection, it is the scanning line 53. -- The level difference configuration is reflected upwards and it is a signal line 54.
[0031] For this reason, the trouble as shown in following ** - ** is invited.
[0032] ** In each above intersection, a crack tends to go into an interlayer insulation film 68, and it is easy to disconnect upper signal-line 54 -- during manufacture. Or by the pinhole in an interlayer insulation film 68, it is easy to short-circuit upper signal-line 54 -- and lower layer scanning-line 53--, they have become, and have lowered the yield.
[0033] ** In each above-mentioned intersection, under the effect of membrane formation residual stress etc., a new crack may arise with time, or the crack produced at the time of membrane formation may spread, a defect occurs after commercialization by this, and dependability falls.
[0034] ** In each above-mentioned intersection, since a big level difference is formed especially, when orientation processing (rubbing processing) of the orientation film is confused or the electric field from signal-line 54 -- work to nearby liquid crystal strongly, it is easy to produce leakage of light.
[0035] ** Since signal-line 54 -- is formed with scanning-line 53 -- on the same substrate, the yield at the time of manufacturing this substrate becomes about equal to what multiplied the yield of the process which forms scanning-line 53 --, and the yield of the process which forms signal-line 54 --, and will cause the fall of the further yield. Although there is relation with other processes and it cannot discuss simply about this point, if it thinks as a certain amount of standard For example, if the yield of the process which forms signal-line 54 -- for the yield of the process which forms scanning-line 53 -- 80% is made into 90% The yield at the time of manufacturing scanning-line 53 -- and the substrate with which signal-line 54 -- was formed becomes 72%, and it will fall rather than the yield at the time of forming scanning-line 53 -- or signal-line 54--.
[0036] ** Since scanning-line 53 -- and signal-line 54-- are formed on the same substrate, it needed to let each process pass in order, and increase of production time has been caused.
[0037] ** It will be necessary with enlargement or highly-minute-izing of a liquid crystal display to narrow the need for scanning-line 53 -- and signal-line 54-- of enlarging die length, and its width of face. By this, the load-carrying capacity in scanning-line 53 -- and signal-line 54-- increases, and delay of a signal arises.
[0038] ** As explained referring to drawing 13 , the display using liquid crystal essentially has a narrow angle of visibility.
[0039] Moreover, with the configuration indicated by above-mentioned JP,5-313159,A, although the viewing-angle dependency of the display screen is improvable to a certain specific direction, it cannot improve about an omnidirection but there is a limitation.
[0040] Furthermore, there is a limitation in improving the reversal of the direction of a stigmatism angle especially with the configuration indicated by above-mentioned JP,6-75116,A. Moreover, in the configuration given in above-mentioned JP,8-50206,A improved rather than the configuration indicated by this JP,6-75116,A, although the viewing-angle property of a longitudinal direction and the direction of a reverse-sight angle improves sharply, the tone reversal of the direction of a stigmatism angle does not fully improve.
[0041] Furthermore, the configuration by the division orientation of JP,7-64096,A is not enough as an improvement of the viewing-angle property of a longitudinal direction or the direction of a reverse-sight angle, although the viewing-angle property of the vertical direction is equalized and the reversal of the direction of a stigmatism angle improves sharply.
[0042] Moreover, no configurations indicated by these JP,5-313159,A, JP,6-75116,A, JP,8-50206,A, and JP,7-64096,A are recognized about the technical problem of ** term from **, although it is effective in the technical problem of the above-mentioned ** term to some extent.
[0043] Moreover, although the structure differs from the configuration which showed the configuration by the above-mentioned IPS method to drawing 11 , drawing 12 , etc., the technical problem of ** term from above ** is not canceled. And since electrode structure serves as the complicated configuration where it entered in the same fields, such as the shape of a sinking comb, the numerical aperture of a

picture element part is low. Therefore, in using for a monitor etc., in order to obtain required brightness (for example, transverse-plane brightness 200 cd/m2 extent), it will be necessary to increase the number of the light sources to 1.5 or more times over the past. Therefore, the weight and the dimension of a liquid crystal display increase and power consumption also becomes large. Moreover, in connection with the output of the light source becoming large, the temperature rise of the liquid crystal display itself becomes high, and there is also a possibility of reducing dependability. Thus, with portable information machines and equipment and the energy-saving goods which considered the environment, it can be said that it is difficult to use the liquid crystal display of such an IPS method. Furthermore, the liquid crystal display of an IPS method is not suitable for the product which needs the angle of visibility of the specific direction, for example like an individual humanity news device which makes the display screen hard to see to a surrounding man.

[0044] Moreover, to the technical problem of the above-mentioned ** term, the configuration proposed by above-mentioned JP,5-27264,A, JP,7-128687,A, etc. is not recognized about the technical problem of ** term from **, although it is effective. Moreover, sufficient viewing-angle property is not acquired with this configuration.

[0045] It is in offering the liquid crystal display which it was made in order that this invention might solve the above-mentioned trouble, and the purpose reduced the short circuit and open-circuit defect of each wiring of the scanning line, a signal line, etc., and raised the manufacture yield, and has improved the viewing-angle dependency, and its manufacture approach.

[0046]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, a liquid crystal display according to claim 1 A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines and the above-mentioned orientation film is characterized by having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode.

[0047] With the conventional configuration, on the same substrate, the laminating of a signal line and the scanning line was carried out, they were formed, thereby, the level difference became large the short

circuit defect of a signal line and the scanning line, and by forming wiring on a substrate over a multilayer, and the problem of generating, such as an open-circuit defect by this, had arisen. However, since according to the above-mentioned configuration a signal line is formed on an opposite substrate and the scanning line is formed on the pixel substrate, it is canceled and the above problems can improve the yield.

[0048] Moreover, since the defect which a crack produces in the interlayer insulation film with which each wiring is insulated, and is generated in it under the effect of membrane formation residual stress etc. can also be abolished, dependability can be raised. Moreover, since it becomes a configuration without a big level difference, generating of the optical leakage by poor orientation processing can also be controlled.

[0049] Moreover, since the scanning line and a signal line are formed on a respectively different substrate, they can be manufactured combining the excellent article of a mutual substrate, and thereby, they can raise the yield rather than it forms the scanning line and a signal line on the same substrate. If it thinks simply, the yield at the time of, for example, manufacturing the yield of the formation process of the scanning line combining these, when the yield of the formation process of 80% and a signal line is made into 90% will become 80%. On the other hand, the manufacture yield becomes 72% when the scanning line and a signal line are formed on the same substrate. That is, the number of excellent articles can be made to raise a little more than ten percent.

[0050] Moreover, since it is formed on a substrate with respectively different the scanning line and a signal line, the parallel mode of each process can be carried out separately, and compaction of production time can be aimed at. In connection with this, compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at.

[0051] Moreover, since the scanning line and a signal line are not close, load-carrying capacity added to each wiring can be made small, and, thereby, signal delay can be reduced.

[0052] Furthermore, according to the above-mentioned configuration, the phase contrast plate is set up so that the index ellipsoid may incline, and the orientation film has two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each pixel electrode. That is, the liquid crystal display concerning this invention has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle at the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle. In case the weak spot of a mutual method can be compensated by this and light passes a liquid crystal layer, phase contrast change produced according to a viewing angle can be compensated efficiently, and an angle of visibility can be improved with sufficient balance over an omnidirection.

[0053] Moreover, the product including a special viewing-angle article of many forms can be manufactured easily, without converting a production line, for example, if each design condition of the above-mentioned phase contrast plate usage and an orientation split plot experiment is changed into according to, respectively.

[0054] The liquid crystal display according to claim 2 is characterized by the above-mentioned orientation film having the orientation field where a viewing angle becomes good to which above or down or an one direction in each above-mentioned pixel field, and the orientation field which becomes good [a viewing angle] to another direction of above or down in the configuration according to claim 1.

[0055] According to the above-mentioned configuration, in each pixel field, since the orientation film has the orientation field where a viewing angle becomes good to which above or down or an one direction, and the orientation field where a viewing angle becomes good to another direction of above or down, it can improve the viewing-angle dependency of the direction of a stigmatism angle still more effectively. Therefore, by combining with the above-mentioned phase contrast plate usage, balance is much more good and an angle of visibility can be improved to an omnidirection.

[0056] The liquid crystal display according to claim 3 is characterized by being set up so that the

direction where the liquid crystal molecule near the orientation film inclines when an electrical potential difference is impressed to a pixel electrode, and the inclination direction of the above-mentioned index ellipsoid may become opposite in the configuration according to claim 1 in the orientation field of the largest area in each above-mentioned pixel field.

[0057] Also in the condition that the electrical potential difference was impressed to the pixel electrode, under the effect of orientation, the standup is weak and the bias of the inclination direction of a liquid crystal molecule has produced the liquid crystal molecule near the orientation film in the thickness direction of a liquid crystal layer. In this point, in the orientation field of the largest area in each pixel field, since the optical property by the liquid crystal molecule and the optical property of a phase contrast plate are set up conversely, according to the above-mentioned configuration, the bias of the inclination direction of the above-mentioned liquid crystal molecule can be compensated with a phase contrast plate. Therefore, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the good display image which is not crushed black can be obtained. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained. In addition, the tone reversal phenomenon of a longitudinal direction can also be controlled.

[0058] In the configuration according to claim 1, the above-mentioned scanning line consists of metals of protection-from-light nature, and the liquid crystal display according to claim 4 is characterized by arranging the boundary of the above-mentioned orientation fields in the location corresponding to the above-mentioned scanning line and/or wiring which consists of metals of protection-from-light nature.

[0059] Without lowering a numerical aperture, since the boundary of orientation fields is arranged in the location corresponding to the scanning line which consists of a metal of protection-from-light nature, and/or other wiring according to the above-mentioned configuration, the optical leak by the poor liquid crystal orientation in the boundary of orientation fields can be covered, and display grace can be raised. Moreover, although the protection-from-light section was formed a little width in consideration of the lamination error of a pixel substrate and an opposite substrate when the protection-from-light section was formed also, for example on an opposite substrate, since such the protection-from-light section can be made into the minimum according to the above-mentioned configuration, a numerical aperture can be gathered further and display grace can be raised.

[0060] It is characterized by establishing two or more orientation fields where orientation processing from which it differs [in / on a configuration according to claim 4 and / in a liquid crystal display according to claim 5 / each above-mentioned pixel field], respectively was performed only in the orientation film on the above-mentioned pixel substrate.

[0061] Since an orientation field, and the scanning line which consists of a metal of protection-from-light nature and/or other wiring are prepared on the same pixel substrate according to the above-mentioned configuration, in case the boundary of orientation fields is covered with the scanning line and/or other wiring, alignment with the boundary of orientation fields, the scanning line, and/or other wiring can be performed with a sufficient precision. Therefore, generating of defects, such as an optical leak, can be reduced. Moreover, since it is not necessary to prepare two or more orientation fields where different orientation processing was performed to the orientation film on an opposite substrate, a manufacture process is simplified and the structure of an opposite substrate is stabilized. Therefore, the lamination of an opposite substrate and a pixel substrate is stabilized and deterioration of the display grace by gap of this lamination can be suppressed.

[0062] The opposite substrate which the manufacture approach of a liquid crystal display according to claim 6 sets a gap between a pixel substrate and the above-mentioned pixel substrate, and is countered and arranged, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and

pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines. The above-mentioned orientation film Are the manufacture approach of a liquid crystal display of having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode, and the above-mentioned orientation film is received. By irradiating light to the above-mentioned orientation film using rubbing down stream processing which performs orientation processing, and the pattern mask corresponding to each above-mentioned orientation field by rubbing processing It is characterized by having optical exposure down stream processing which performs orientation processing different, respectively to each orientation field.

[0063] According to the above-mentioned approach, rubbing processing by which stable production is carried out by a certain amount of yield, and orientation processing by irradiating light using a pattern mask are performed from the former. That is, the rubbing processing which production conditions were established and is stable performs overall orientation processing, and the optical exposure is performing only control of a delicate orientation condition. Therefore, since the fault of both methods is suppliable, it becomes possible to be stabilized and to mass-produce a quality liquid crystal display.

[0064] In the approach according to claim 6, the above-mentioned orientation field is set up for the manufacture approach of a liquid crystal display according to claim 7 in [two] each above-mentioned pixel field, and the above-mentioned optical exposure process is characterized by being carried out only to one of the above-mentioned orientation fields.

[0065] Since an optical exposure process is performed only to one of the above-mentioned orientation fields according to the above-mentioned approach, what is necessary will be to perform the exposure of light only once. Therefore, the problem of the orientation processing defect by surroundings lump of the light accompanying the orientation processing by the exposure of light etc., the problem of the durable dependability of the orientation processing field by the exposure of light, etc. can be made into the minimum. Moreover, to coincidence, since the exposure process of light can be lessened, reduction of a manufacturing cost can be aimed at.

[0066]

[Embodiment of the Invention] [Gestalt 1 of operation] It will be as follows if one gestalt of operation of this invention is explained based on drawing 1 thru/or drawing 8 .

[0067] The liquid crystal display 1 concerning this operation gestalt has composition equipped with the liquid crystal display component 5, phase contrast plate 2a and 2b which are arranged in contact with the field of the both sides of the liquid crystal display component 5, and the polarizing plate 3-4 arranged in contact with an outside field at the pan of phase contrast plate 2a and 2b, as shown in drawing 6 .

[0068] The above-mentioned liquid crystal display component 5 is equipped with the liquid crystal layer 12 pinched by enclosing a perimeter by the sealant 13 in the gap of the opposite substrate 6 which

consists of a translucency substrate, the pixel substrate 7 which similarly consists of a translucency substrate, and the opposite substrate 6 and the pixel substrate 7.

[0069] The orientation film 10 which becomes signal-line 8 -- which consists of ITO (Indium Tin Oxide) etc. from polyimide, polyvinyl alcohol, etc., and two or more color filters (not shown) divided and arranged for every pixel are formed in the front face of the opposite substrate 6. Similarly, the orientation film 11 which becomes pixel electrode 9 -- which consists of ITO etc. from polyimide, polyvinyl alcohol, etc. is formed in the front face of the pixel substrate 7. Each pixel electrode 9 is arranged corresponding to the location of the color filter of each color formed on the opposite substrate 6.

[0070] Moreover, the light source 14 and a transparent material 15 are arranged on the outside by the side of the pixel substrate 7 in a liquid crystal display 1. A transparent material 15 is a plate of the magnitude of about same extent as the field of the liquid crystal display component 5, and the light source 14 is arranged in the long and slender configuration on the outside of the one side of a transparent material 15. Homogeneity distributes in a transparent material 15 and the light which carried out outgoing radiation from the light source 14 is irradiated all over the field equivalent to the display screen in a liquid crystal display 1. The configuration which doubled this light source 14, the transparent material 15, and the member of the circumference of it is called a back light unit.

[0071] In addition, in this operation gestalt, although only one LGT is arranged on the outside of the one side of a transparent material 15, the light source 14 can also be considered as the configuration which arranges two or more light source 14 -- also on the outside of other sides of a transparent material 15, and a configuration which the one light source 14 is made crooked and surrounds the perimeter of a transparent material 15, when the quantity of light needs to be raised more. Moreover, it is also possible to consider as the configuration in a transparent material 15 which arranges two or more light source 14 -- and the light source 14 made crooked with the liquid crystal display component 5 side on the outside of the field of the opposite side.

[0072] Rubbing processing is beforehand performed so that each front face of the orientation film 10-11 can be twisted at about 90 degrees and the intervening liquid crystal molecule may carry out orientation. As shown in drawing 2 , in the above-mentioned liquid crystal display component 5, rubbing processing is performed in the direction of an arrow head 21 to the orientation film 10 on the opposite substrate 6, and more specifically to the orientation film 11 on the pixel substrate 7, rubbing processing is performed so that it may become the direction of the arrow head 22 which intersects perpendicularly to an arrow head 21. In addition, the direction of an arrow head 21 and an arrow head 22 is hereafter called the direction 21 of rubbing, and the direction 22 of rubbing, respectively.

[0073] As shown in drawing 3 , the above-mentioned polarizing plate 3-4 is arranged so that each absorption shaft orientations 23-24 may intersect perpendicularly mutually. Therefore, when not impressing an electrical potential difference to the liquid crystal layer 12, the liquid crystal display 1 serves as the so-called normally white means of displaying which penetrates light and performs a white display. At this time, the absorption shaft orientations 23 of a polarizing plate 3 and the direction 21 of rubbing of the above-mentioned orientation film 10 are set up so that it may become parallel mutually. Moreover, similarly, the absorption shaft orientations 24 of a polarizing plate 4 and the direction 22 of rubbing of the above-mentioned orientation film 11 are set up so that it may become parallel mutually.

[0074] Here, in phase contrast plate 2a and 2b, the direction of the principal indices of refraction nb which incline in the direction which gives an anisotropy to this phase contrast plate 2a and 2b defines the direction projected on the front face of phase contrast plate 2a and 2b as main refraction projection direction 25aand25b, respectively. At this time, as shown in drawing 3 , main refraction projection direction 25a in phase contrast plate 2a and the direction 21 of rubbing of the orientation film 10 are set up so that it may become the same direction mutually in parallel. Similarly, main refraction projection direction 25b in phase contrast plate 2b and the direction 22 of rubbing of the orientation film 11 are set up so that it may become the same direction mutually in parallel.

[0075] In addition, the above-mentioned phase contrast plate 2a and 2b will become possible [compensating phase contrast], if at least one sheet intervenes between a polarizing plate 3 and a

polarizing plate 4: Furthermore, phase contrast plate 2a or two or more phase contrast plate 2bs may intervene between a polarizing plate 3 and the liquid crystal display component 5 or between a polarizing plate 4 and the liquid crystal display component 5. in addition, between the liquid crystal display component 5 and both polarizing plates 3-4 -- phase contrast plate 2a and 2b -- respectively -- two or more sheets -- two or more sheets may intervene.

[0076] As for phase contrast plate 2a used for the above-mentioned liquid crystal display 1, as shown in drawing 4 , in a representation layer, three principal-indices-of-refraction na-nb-nc of an index ellipsoid has at least the relation of na=nc>nb, i.e., the relation from which a refractive-index anisotropy serves as negative, on the average as the whole phase contrast plate 2a. Thereby, phase contrast plate 2a is equipped with optically uniaxial [in which one optical axis exists]. include-angle theta Moreover, a definition of the rectangular coordinate system xyz which makes the front face of the above-mentioned phase contrast plate 2a a x-y flat surface has inclined the direction of the principal indices of refraction nb in the direction of an arrow head A to the direction z-axis of a normal of the front face of phase contrast plate 2a. include-angle theta Furthermore, the principal indices of refraction nc also lean in the direction of an arrow head B to the direction of a x axis parallel to the front face of phase contrast plate 2a.

[0077] Namely, in phase contrast plate 2a, the index ellipsoid is in the condition of inclining at the include angle theta counterclockwise centering on the direction of the principal indices of refraction na, as a whole. The inclination of this index ellipsoid may incline clockwise centering on the direction of the principal indices of refraction na. In addition, since it is the configuration same also about phase contrast plate 2b as the above-mentioned phase contrast plate 2a, explanation is omitted.

[0078] With the gestalt of this operation, the inclination of the principal indices of refraction nb uses that whose above-mentioned include angle theta is about 20 degrees as phase contrast plate 2a and 2b. In the principal indices of refraction nc, at this time, the above-mentioned include angle theta is about 20 degrees similarly. That is, 20 degrees of index ellipsoids will incline counterclockwise centering on the direction of the principal indices of refraction na.

[0079] By setting the retardation value of the above-mentioned phase contrast plate 2a and 2b as a different value, the compensation function of phase contrast can be obtained certainly. As the above-mentioned retardation value, there are the 1st and 2nd retardation values. the 1st retardation value -- as the whole phase contrast plate 2a and 2b -- difference nc-na of the principal indices of refraction nc and the principal indices of refraction na, and thickness df of phase contrast plate 2a and 2b Product (nc-na) xdf it is . on the other hand, the 2nd retardation value -- difference nc-nb of the principal indices of refraction nc and the principal indices of refraction nb, and phase contrast plate 2a and thickness df of 2b Product (nc-nb) xdf it is .

[0080] With the gestalt of this operation, as phase contrast plate 2a and 2b, discotheque liquid crystal is applied to the transparent base materials (for example, triacetyl cellulose (TAC) etc.) of 80% or more of transmission, inclination orientation of the discotheque liquid crystal is specifically carried out, and that whose 2nd retardation value said 1st retardation value is 0nm, and is 100nm is used.

[0081] The discotheque liquid crystal by which inclination orientation is carried out to the above-mentioned phase contrast plate 2a and 2b forms the layer for the discotheque structure which is a disk configuration in a liquid crystal molecule as one structural unit. The tilt angle of the disk side in one unit of this discotheque structure and the front face of this phase contrast plate 2a and 2b to make is changing to continuation or discontinuity in the depth direction of this phase contrast plate 2a and 2b. As for the above-mentioned tilt angle, at this time, it is desirable that the average is 15 degrees - 75 degrees.

[0082] Since formation of the layer of the above-mentioned discotheque liquid crystal can be formed by the applying method as compared with the conventional manufacture approaches, such as an extension process type, phase contrast plate 2a and 2b can be easily manufactured by low cost.

[0083] And the manufacture approach of phase contrast plate 2a and 2b does not need to manage the homogeneity of tension like an extension process type, is easy, and low cost. From this, a large-sized product (for example, 20 inches or more) can also be manufactured with sufficient quality more easily than before. In addition, in this operation gestalt, the product marketed from Fuji Photo Film was used

as phase contrast plate 2a and 2b.
[0084] Here, in the liquid crystal display using the conventional phase contrast plate, the trouble that the viewing-angle difference of the right and left in this display screen became large was produced, so that the display screen became large. Especially in the display screen where a screen size becomes 20 inches or more, supposing it saw the location where an observer separates from this display screen 50cm with a vertical distance, and a viewing angle serves as the above around 50 degrees to the core of this display screen to the display screen, it saw from the observer and the remarkable coloring phenomenon was observed in the edge of a far side.
[0085] When the above-mentioned vertical distance became small, the check include angle of the above-mentioned coloring phenomenon was still smaller from 50-degree order. Moreover, when the conventional display whose screen size is 15 inches was also 35cm in the above-mentioned vertical distance, the remarkable coloring phenomenon was too checked in the right-and-left viewing angle of about 50 degrees.
[0086] However, in addition to the ability to manufacture a large-sized phase contrast plate easily, the quality variation and debasement accompanying enlargement also decrease with the phase contrast plate constituted from discotheque liquid crystal which was mentioned above. For this reason, phase contrast plate 2a and 2b of high quality can be obtained conventionally.
[0087] therefore, in the liquid crystal display 1 of this operation gestalt Also in the liquid crystal display which has the large-sized display screen where a viewing-angle difference is easy to be recognized (1) A screen size with a small observation distance from a screen of a personal application A liquid crystal display 15 inches or more, (2) the screen size observed from an extensive viewing angle although the observation distance used as various monitors leaves a few as a monitor for a liquid crystal display 20 inches or more, (3) home use, business use, or OA the liquid crystal display from 20 inches or more to about 40 inches with the large-sized screen size which is required in recent years and is being developed -- it comes out, and even if it is, a high definition display is realizable.
[0088] Moreover, the tilt angle of the optical anistropic axis in this phase contrast plate 2a and 2b can change orientation processing, an ingredient, etc. of a substrate in the thickness direction of phase contrast plate 2a and 2b easily by choosing suitably at this time. It can add to optical compensation of phase contrast plate 2a and 2b for doubling with the property of the liquid crystal of the liquid crystal display component 5 by this, and optimal optical amendment can be easily performed according to the optical property of the configuration member by the side of the interior of the liquid crystal display component 5, and the exterior (liquid crystal side) (atmospheric-air side), for example, the refractive index which liquid crystal shows. Therefore, phase contrast plate 2a and 2b of the optimal structure can be obtained easily.
[0089] Although there was a little yellow taste of level with difficult discernment when the above-mentioned phase contrast plate 2a and 2b were used to the liquid crystal display 1 and the display screen was inspected visually for this from the direction 60 to 70 degrees or more right and left and a top, coloring and reversal serve as hardly worried extent, and the display beautiful enough was obtained.
[0090] Moreover, by repeating and applying discotheque liquid crystal to a transparent base material as the above-mentioned phase contrast plate 2a and 2b, and changing the inclined plane of the disk side of a discotheque liquid crystal structural unit in the thickness direction, hybrid orientation of the discotheque liquid crystal was carried out, and it used for the liquid crystal display 1 about the thing whose 2nd retardation value said 1st retardation value is 0nm, and is 100nm as well as the above.
[0091] Even in this case, when the display screen of a liquid crystal display 1 was inspected visually from the direction 60 to 70 degrees or more right and left and a top, coloring and reversal were not seen but the beautiful display was obtained.
[0092] Since it becomes possible since the phase contrast of the forward Tsunemitsu and abnormality light which are produced according to a viewing angle by using the above-mentioned phase contrast plate 2a and 2b is compensated with a large area with sufficient quality to change into the linearly polarized light over the range where a viewing angle is large and the coloring phenomenon and reversal accompanying viewing-angle change can be canceled, the liquid crystal display 1 with few viewing-

angle dependencies can be obtained.
[0093] It is desirable that refractive-index anisotropy deltan (450) to light with a wavelength of 450nm and difference deltan(450)-delta[of refractive-index anisotropy deltan (650) to light with a wavelength of 650nm] n (650) use the liquid crystal set as or more 0 0.01 or less range as liquid crystal in the liquid crystal display 1 of this operation gestalt with the above-mentioned phase contrast plate 2a and 2b. In this case, the coloring from a slanting angle of visibility can be reduced more, and extent which does not worry the yellow taste near the angle-of-visibility limitation at all, either is solved.
[0094] In optical elements, such as the above-mentioned phase contrast plate 2a and 2b, and a polarizer 3-4, the refractive-index anisotropies over the wavelength of light usually differ in each part of this optical element. For example, although used as current phase contrast plate 2a and 2b, the refractive-index anisotropy of many is large at a short wavelength side, and it is small by the tidal-wave length side. For this reason, the phase contrast of the forward Tsunemitsu and abnormality light which are produced according to a viewing angle can be compensated still more effectively than before by using liquid crystal with the small difference of the refractive-index anisotropy by the side of short wavelength, and the refractive-index anisotropy by the side of tidal-wave length combining the above-mentioned phase contrast plate 2a and 2b.
[0095] As liquid crystal, using 0.07 and the liquid crystal ingredient which are 0.08 and 0.095, refractive-index anisotropy deltan (550) to light with a wavelength of 550nm set the cel thickness (thickness of the liquid crystal layer 12) of the liquid crystal display component 5 as about 4.5 micrometers, and, specifically, checked the good display with this operation gestalt. Since the smaller one tends to improve an angle-of-visibility property, cel thickness is developing the configuration which set current and cel thickness to about 3 micrometers.
[0096] Moreover, in the liquid crystal layer 12, as explained referring to drawing 2 and drawing 3 , where 90 degrees is twisted, orientation of the liquid crystal molecule is carried out. In addition, since the means of displaying of a normally white method is adopted, the display contrast, the color reproduction nature, and the viewing-angle dependency of the display screen can be raised more. Since white can be especially displayed more vividly by the normally white method, it is more desirable than a normally black method.
[0097] Next, the structure of the pixel substrate 7 with which the liquid crystal display 1 of this operation gestalt is equipped, and its front face is explained below.
[0098] Drawing 5 is the sectional view showing the outline of the structure of the pixel substrate 7 and its front face. On the pixel substrate 7, two or more TFT31 -- as a switching element is formed, and two or more pixel electrode 9 -- is further formed on it.
[0099] Above-mentioned TFT31 -- has the following composition. The gate electrode 32 is formed on the pixel substrate 7, and gate dielectric film 33 is formed so that this may be covered. The semi-conductor thin film 34 is formed in the upper part of the gate electrode 32 through gate dielectric film 33. Source electrode (contact layer) 35a which consists of a microcrystal n+ silicon layer is formed in the source section side of this semi-conductor thin film 34, and drain electrode 35b (contact layer) which similarly consists of a microcrystal n+ silicon layer is formed in the drain section side. Moreover, source wiring 36 is formed in the pan of source electrode 35a at the upper layer, and the drain wiring 37 is formed in the pan of drain electrode 35b at the upper layer. In addition, in this operation gestalt, the pixel electrode 9, source wiring 36, and the drain wiring 37 consist of same ingredients. Moreover, in order to attain simplification of a manufacture process, in the conventional configuration, the channel protective coat formed in the central upper part of the semi-conductor thin film 34 is not formed in this operation gestalt.
[0100] The pixel electrode 9 is connected to the source wiring 36 of the above TFT31, and the datum line 38 is connected to the drain wiring 37. In addition, drawing 5 is not necessarily drawing having shown the straight-line cross section.
[0101] Drawing 1 is the perspective view showing the outline configuration of the liquid crystal display component 5. As shown in drawing 1 , the pixel electrode 9 is divided into division picture element part 9a and 9b from which liquid crystal orientation differs, and the datum line 38 is running along it in the

gap of division picture element part 9a and 9b. This division picture element part 9a and 9b are formed so that it may become surface ratio 17:3. Thus, viewing-angle dependence of the direction of a stigmatism angle is improvable by dividing the pixel electrode 9 into division picture element part 9a and 9b from which liquid crystal orientation differs.

[0102] Here, the surface ratio of division picture element part 9a and 9b is explained. When the surface ratio of division picture element part 9a and 9b is changed, if one side becomes good, property change which conflicted mutually that another side gets worse is shown by the tone reversal and contrast of the direction of a stigmatism angle.

[0103] When the above-mentioned surface ratio is 17:3, more specifically, both the limitation of the contrast in the direction of a stigmatism angle and the limitation of tone reversal become about 40 degrees. On the other hand, when the above-mentioned surface ratio is 19:1, the limitation of the tone reversal in the direction of a stigmatism angle is about 37-38 degrees, and improves rather than 35 degrees which is the limitation of the tone reversal of the conventional optical compensating plate method. Moreover, the limitation of contrast is sufficient viewing-angle limitation 55 degrees or more. Moreover, when the above-mentioned surface ratio is 6:4, as for the limitation of 20 degrees or more and tone reversal, the limitation of the contrast in the direction of a stigmatism angle is 50 degrees or more. In addition, the fall of contrast is seldom worried, when actually observing comparing with tone reversal.

[0104] As for the surface ratio of division picture element part 9a and 9b, it is more desirable than the above result to be set up in 6:4 to 19:1. When set up in such range, the balance of control of tone reversal and improvement in contrast becomes good. For example, when it is the liquid crystal display of a 20 inch screen size, in the direction of a stigmatism angle, a good display can be observed in the viewing angle of about 40 degrees by about 20 degrees and max at the lowest. In addition, in a longitudinal direction and the direction of a reverse-sight angle, a good display is observable in the viewing angle of 50-70 degrees at this time.

[0105] And division picture element part 9a and 9b are connected by pixel connection section 9c and 9c in the both ends of the gap of division picture element part 9a and 9b. Thus, since only pixel connection section 9cand9c are formed in the upper part of the datum line 38, generating of poor leak can be reduced, for example as compared with the case where the whole surface of the pixel electrode 9 is formed in the upper part of the datum line 38.

[0106] Scanning-line 32 -- and datum-line 38-- are formed by the monolayer or multilayer structure with the metallic material of protection-from-light nature, such as a tantalum, tantalum nitride, and aluminum.

[0107] In addition, the counterelectrode formed on the opposite substrate 6 corresponding to the pixel electrode 9 was formed with the same width of face and the same ingredient in this operation gestalt succeeding the signal line 10. However, as a large-sized liquid crystal display panel shows to drawing 7 , it is good also as the reduction in resistance of wiring resistance, and a configuration which connects the counterelectrode 39 which consists of transparence electric conduction film with the signal line 40 which consists of a metal membrane of protection-from-light nature thinner than it in order to improve the protection-from-light nature of unnecessary light.

[0108] The pre tilt angle given to a liquid crystal molecule is changed in each top face of the above-mentioned division picture element part 9a and 9b, or the orientation film 11 (not shown in drawing 1) is formed in it so that it may become the field to which orientation differs mutually with a method, such as making the direction of a tilt of a liquid crystal molecule into the opposite sense mutually in a field.

[0109] In each of division picture element part 9a and 9b, if the orientation art changed into a different orientation condition is carried out, one field is covered by a resist etc. and there are an approach of carrying out rubbing processing of another field, the approach of changing optical exposure conditions for every field, and carrying out orientation processing using the orientation processing by optical exposure, etc. In the case of the former approach, there are problems, like contamination and deterioration of the orientation processing section arise by processing at the time of the resist remainder whose percent defective by the static electricity destruction which a rubbing man day increases

increases, and resist exfoliation etc. As for the orientation processing by optical exposure, in the case of the latter approach, mass production technology is not fully established. for example, the case where orientation conditions are mutually changed in the minute field which the durable dependability when adding the optical exposure supposing an outdoor natural light exposure was inadequate, or adjoined -- light -- turning -- being crowded -- etc. -- there is a problem of the poor orientation to depend occurring.
[0110] With this operation gestalt, first, to the orientation film 10-11, orientation processing by rubbing is performed, either division picture element part 9a or 9b are covered with a pattern mask after that, and, on the whole, the delicate orientation condition is adjusted by performing an optical exposure. With this method, the good liquid crystal display component 5 of quality can be manufactured with sufficient productivity.
[0111] In this operation gestalt, it is each of the orientation film on division picture element part 9a, the orientation film on division picture element part 9b, and the orientation film by the side of the opposite substrate 6, and orientation processing was performed, respectively so that a pre tilt angle might become 5 degrees, 2 degrees, and about 3 degrees by the correlation sample. However, on an actual panel, a pre tilt angle is not uniform, and what inclines delicately and is distributed is conjectured by the effect of reflection of exposure light, a surroundings lump, etc.
[0112] Thus, by each of the orientation film on division picture element part 9a, the orientation film on division picture element part 9b, and the orientation film by the side of the opposite substrate 6, since orientation processing is performed so that pre tilt angles may differ, the pre tilt of the liquid crystal near the center section of the liquid crystal layer 12 is hard flow mostly mutually, and, thereby, a viewing-angle dependency is improved.
[0113] Moreover, in this operation gestalt, the direction where the liquid crystal molecule of a field with a larger area among division picture element part 9a and 9b (division picture element part 9a near [i.e.,]) inclines when an electrical potential difference is impressed with the pixel electrode 9, and the inclination direction of the index ellipsoid in phase contrast plate 2a and 2b are set up so that it may become an opposite direction mutually. This is explained in detail by the following.
[0114] Also in the condition that the electrical potential difference was impressed to the pixel electrode 9, under the effect of orientation, the standup is weak and the bias of the inclination direction of a liquid crystal molecule has produced the about 10-11 orientation film liquid crystal molecule in the thickness direction of the liquid crystal layer 12. According to the above-mentioned configuration, in this point, the bias of the inclination direction of the above-mentioned liquid crystal molecule can be compensated with phase contrast plate 2a and 2b. Therefore, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the good display image which is not crushed black can be obtained. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained. In addition, the tone reversal phenomenon of a longitudinal direction can also be controlled.
[0115] In addition, with this operation gestalt, orientation processing was performed by irradiating light only once to the orientation film which has the pre tilt angle of 2 degrees and 3 degrees among each orientation film with the pre tilt angle of 5 degrees, 2 degrees, and 3 degrees. Thereby, since the number of processes of orientation processing can be reduced, dispersion in a man day, a percent defective, and an orientation processing state etc. can be reduced.
[0116] Although a visible ray and infrared radiation were sufficient as the exposure light used in the case of this orientation processing, high energy was obtained easily and ultraviolet rays were used for it from the reason nil why dependability is comparatively stable etc. A high pressure mercury vapor lamp is used for exposure conditions, and they are 5000 mJ/cm2. It is the energy per unit area and the exposure was performed for 5 minutes.
[0117] Drawing 8 (a) thru/or (d) are the explanatory views showing the flow of orientation film formation down stream processing. As shown in drawing 8 (a) thru/or (d), at orientation film formation down stream processing, an orientation film spreading process, a baking process, a rubbing process, and a washing process are performed in this order. And the process (optical exposure process) which performs the further above-mentioned optical exposure is performed after a baking process (in the case

of drawing 8 (b)) in either after a rubbing process or a washing process (in the case of drawing 8 (c)) (in the case of drawing 8 (d)) after an orientation film spreading process (in the case of drawing 8 (a)).
[0118] As mentioned above, in the liquid crystal display 1 concerning this operation gestalt, since signal-line 8 -- is formed on a respectively different substrate with scanning-line 32 --, it can manufacture combining the excellent article of a mutual substrate, and thereby, the yield can be raised rather than it forms signal-line 8 -- on the same substrate with scanning-line 32 --.
[0119] Moreover, since signal-line 8 -- is formed on a respectively different substrate with scanning-line 32 --, the parallel mode of each process can be carried out separately, and compaction of production time can be aimed at. In connection with this, compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at.
[0120] Moreover, since signal-line 8 -- is not close with scanning-line 32 --, load-carrying capacity added to each wiring can be made small, and, thereby, signal delay can be reduced. In addition, load-carrying capacity compares with scanning-line 32 -- with the configuration with signal-line 8 -- which forms the conventional scanning line and a conventional signal line on the same substrate although not necessarily prescribed by only the capacity of a between, and is the scanning line 32. -- They are 1/6 or less and a signal line 8 at a side. -- It checked by simulation that a time delay could be reduced or less to 1/4 by the side.
[0121] Moreover, the liquid crystal display 1 concerning this operation gestalt has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle at the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle. In case the weak spot of a mutual method can be compensated by this and light passes the liquid crystal layer 12, phase contrast change produced according to a viewing angle can be compensated efficiently, and an angle of visibility can be improved with sufficient balance over an omnidirection.
[0122] [Gestalt 2 of operation] It will be as follows if other gestalten of operation of this invention are explained based on drawing 9 and drawing 10 . In addition, the same sign is appended to the configuration explained with the above mentioned gestalt 1 of operation, and the configuration which has the same function, and the explanation is omitted.
[0123] Drawing 9 is the perspective view showing the outline configuration of the liquid crystal display component in the liquid crystal display concerning this operation gestalt. Like the configuration in the gestalt 1 of operation, the liquid crystal layer 12 is pinched by the gap of the pixel substrate 7 and the opposite substrate 6, TFT31 --, scanning-line 32--, datum-line 38--, and pixel electrode 43-- are formed on the pixel substrate 7, and the signal line 8 is formed on the opposite substrate 6 by this liquid crystal display component.
[0124] The above-mentioned pixel electrodes 43 differ in the pixel electrode 9 in the gestalt 1 of operation, and have the composition that the division picture element part was not formed but the electrode was continuously formed also on the datum line 38.
[0125] Drawing 10 is the sectional view showing the cross-section structure of the above-mentioned liquid crystal display component. On the pixel substrate 7, scanning-line 32 -- and datum-line 38-- are formed, insulator layer 33 -- which consists of non-equipments is further formed on them, and scanning-line 32 -- and datum-line 38-- are protected firmly. Moreover, the interlayer insulation film 42 of a low dielectric constant of scanning-line 32 -- and the pixel substrate 7 with which datum-line 38 -- and insulator layer 33-- were formed is mostly formed in the whole surface. This interlayer insulation film 42 consists of organic materials in which flattening is possible.
[0126] Pixel electrode 43 -- is formed in the upper layer of this interlayer insulation film 42. By such structure, it is the pixel electrode 43. -- An edge can be superimposed in a part superficially [scanning-line 32 -- as a lower layer protection-from-light metal layer]. Therefore, since the numerical aperture of a pixel can be improved, improvement in brightness and reduction of the power consumption of a back light can be aimed at.
[0127] Moreover, since it is shaded by above-mentioned scanning-line 32 -- etc., the orientation

turbulence of the surrounding liquid crystal of each pixel electrode 43 can make line breadth of the black matrix 47 small compared with the case where a protection-from-light pattern is arranged only to the opposite substrate 6. In the case where this arranges a protection-from-light pattern only for the opposite substrate 6, the black matrix 47 in the opposite substrate 6 is because the line breadth was set up width somewhat in consideration of the lamination error (about 5 micrometers) of the opposite substrate 6 and the pixel substrate 7. Moreover, it is also possible to consider as the design which protection from light by above-mentioned scanning-line 32 -- can perform completely, then the configuration which excluded the black matrix 47, and reduction of a production process and ingredient cost can be aimed at in this case.

[0128] On the pixel electrode 43, orientation film 44a and 44b which changes the pre tilt angle of liquid crystal mutually are formed.

[0129] On the other hand, on the opposite substrate 6, red, green, and color filter layer 46 -- corresponding to each blue color are formed in the location corresponding to each pixel, and it is this color filter layer 46. -- Black matrix 47 -- which has a protection-from-light function is formed in the gap of comrades. Moreover, color filter layer 46 -- and the black matrix 47 -- The flattening protective coat 48 and signal-line 8 which also has function of counterelectrode in the upper layer further -- are formed at the upper layer. Furthermore, signal line 8 -- The orientation film 10 of the opposite substrate 6 mostly formed uniformly over the whole surface is formed in the upper layer.

[0130] In the liquid crystal layer 12 with which it filled up between the opposite substrate 6 and the pixel substrate 7, the liquid crystal near a center to the thickness direction is arranged with a mutually different tilt angle corresponding to each field of the above-mentioned orientation film 44a and 44b, when the electrical potential difference is not impressed. The viewing-angle dependency of the vertical direction is improved by this.

[0131] Here, the above-mentioned interlayer insulation film 42 is explained to a detail. As an ingredient which constitutes an interlayer insulation film 42, since a formation process becomes simple, photosensitive resin is desirable. Moreover, since the one where the parasitic capacitance in an interlayer insulation film 42 is smaller can perform a good display, an ingredient with a low dielectric constant is desirable. As a concrete ingredient, the diameter photopolymer of an acrylic, benz-cyclo-butene (Benzosyclobutene), or transparent and colorless polyimide is desirable, for example. These ingredients are excellent in transparency and have high dependability with the low dielectric constant comparatively.

[0132] As for the thickness of this interlayer insulation film 42, it is desirable that it is the range of about 1.5 to about 3.5 micrometers. About the minimum of this range, the level difference in the lower layer of an interlayer insulation film 42 is 200nm - hundreds of nm, and it is set up for the reasons of obtaining the surface smoothness of the top face of an interlayer insulation film 42, lowering the parasitic capacitance by the interlayer insulation film 42. Moreover, about the upper limit of the above-mentioned range, it is set up for the reasons of making reduction of the permeability of light into the minimum, controlling dispersion in the thickness of the liquid crystal layer 12 by the elastic deformation of an interlayer insulation film 42, holding down the cost of materials.

[0133] In the ingredient of the above-mentioned interlayer insulation film 42, if it is the ingredient with which the specific inductive capacity becomes about two to 4 between, the ingredient which fulfills the above-mentioned conditions can come to hand.

[0134]

[Effect of the Invention] As mentioned above, the liquid crystal display concerning invention of claim 1 A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-

mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines and the above-mentioned orientation film is the configuration of having two or more orientation fields where orientation processing different, respectively was performed, in each pixel field corresponding to each above-mentioned pixel electrode.

[0135] Thereby, the problem of generating, such as a short circuit defect of a signal line and the scanning line and an open-circuit defect a level difference becomes large by forming wiring on a substrate over a multilayer, and according to this, is solved, and the effectiveness that the yield can be improved is done so.

[0136] Moreover, since it becomes the configuration which can raise dependability and does not have a big level difference since the defect which a crack produces in the interlayer insulation film with which each wiring is insulated, and is generated in it under the effect of membrane formation residual stress etc. can also be abolished, the effectiveness that generating of the optical leakage by poor orientation processing can also be controlled is done so.

[0137] Moreover, the effectiveness that the yield can be raised is done so rather than it forms the scanning line and a signal line on the same substrate.

[0138] Moreover, since compaction of production time can be aimed at, the effectiveness that compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at is done so.

[0139] Moreover, since the scanning line and a signal line are not close, load-carrying capacity added to each wiring can be made small, and this does so the effectiveness that signal delay can be reduced.

[0140] Furthermore, to the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle, since it has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle In case the weak spot of a mutual method can be compensated and light passes a liquid crystal layer, phase contrast change produced according to a viewing angle is compensated efficiently, and the effectiveness that an angle of visibility is improvable with sufficient balance over an omnidirection is done so.

[0141] The liquid crystal display concerning invention of claim 2 is the configuration that the above-mentioned orientation film has the orientation field which becomes good [a viewing angle] in each above-mentioned pixel field to the orientation field where a viewing angle becomes good to which above or down or an one direction, and another direction of above or down.

[0142] the effectiveness according to the configuration of claim 1 by this -- in addition, since the viewing-angle dependency of the direction of a stigmatism angle can be improved still more effectively,

the effectiveness that balance is much more good and an angle of visibility can be improved to an omnidirection is done so by combining with the above-mentioned phase contrast plate usage.
[0143] The liquid crystal display concerning invention of claim 3 is a configuration set up so that the direction where the liquid crystal molecule near the orientation film inclines when an electrical potential difference is impressed to a pixel electrode, and the inclination direction of the above-mentioned index ellipsoid may become opposite in the orientation field of the largest area in each above-mentioned pixel field.
[0144] Thereby, since the bias of the inclination direction of a liquid crystal molecule can be compensated with a phase contrast plate in addition to the effectiveness by the configuration of claim 1, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the effectiveness that the good display image which is not crushed black can be obtained is done so. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained, in addition the effectiveness that the tone reversal phenomenon of a longitudinal direction can also be controlled is done so.
[0145] The liquid crystal display concerning invention of claim 4 is the configuration that the boundary of the above-mentioned orientation fields is arranged in the location corresponding to wiring which the above-mentioned scanning line consists of metals of protection-from-light nature, and consists of metals of the above-mentioned scanning line and/or protection-from-light nature.
[0146] Thereby, without lowering a numerical aperture in addition to the effectiveness by the configuration of claim 1, the optical leak by the poor liquid crystal orientation in the boundary of orientation fields can be covered, and the effectiveness that display grace can be raised is done so.
[0147] Two or more orientation fields where, as for the liquid crystal display according to claim 5, orientation processing from which it differs in each above-mentioned pixel field, respectively was performed are configurations prepared only in the orientation film on the above-mentioned pixel substrate.
[0148] Thereby, in case the boundary of orientation fields is covered with the scanning line and/or other wiring in addition to the effectiveness by the configuration of claim 4, alignment with the boundary of orientation fields, the scanning line, and/or other wiring can be performed with a sufficient precision, and the effectiveness that generating of defects, such as an optical leak, can be reduced is done so.
[0149] The manufacture approach of the liquid crystal display concerning invention of claim 6 A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon

the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines. The above-mentioned orientation film Are the manufacture approach of a liquid crystal display of having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode, and the above-mentioned orientation film is received. It has rubbing down stream processing which performs orientation processing by rubbing processing, and optical exposure down stream processing which performs orientation processing which is different to each orientation field, respectively by irradiating light to the above-mentioned orientation film using the pattern mask corresponding to each above-mentioned orientation field.

[0150] Thereby, the rubbing processing which production conditions were established and is stable performs overall orientation processing, and the optical exposure is performing only control of a delicate orientation condition. Therefore, since the fault of both methods is suppliable, the effectiveness of becoming possible to be stabilized and to mass-produce a quality liquid crystal display is done so.

[0151] The above-mentioned orientation field is set up for the manufacture approach of the liquid crystal display concerning invention of claim 7 in [two] each above-mentioned pixel field, and the above-mentioned optical exposure process is performed only to one of the above-mentioned orientation fields.

[0152] In addition to the effectiveness by the approach of claim 6, this does so the effectiveness that the problem of the orientation processing defect by surroundings lump of the light accompanying the orientation processing by the exposure of light etc., the problem of the durable dependability of the orientation processing field by the exposure of light, etc. can be made into the minimum. Moreover, to coincidence, since the exposure process of light can be lessened, the effectiveness that reduction of a manufacturing cost can be aimed at is done so.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the liquid crystal display equipped with switching elements, such as a thin film transistor, and its manufacture approach.

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PRIOR ART

[Description of the Prior Art] Before, the liquid crystal display using the liquid crystal display component of a pneumatic mold is widely used for liquid crystal displays of a numerical segmental die, such as a clock and a calculator. Also in recently, taking advantage of the descriptions, such as a thin shape, a light weight, and a low power, the liquid crystal display was used as displays including a word processor, a computer, and a navigation system, and has expanded the commercial scene widely.
[0003] The liquid crystal display of the active-matrix mold which allotted the pixel in the shape of a matrix is widely used with the height of the display grace among the above-mentioned liquid crystal displays these days, using active elements, such as TFT (Thin Film Transistor), as a switching element.
[0004] since such a liquid crystal display has advantages, like that thickness (depth) is boiled markedly and can be made thin as compared with CRT (Cathode Ray Tube), that power consumption is small, and full-color-izing is easy, the need has spread in broad fields, such as a notebook computer, a monitor for games, pocket television, and a digital camera. However, since the conventional liquid crystal display is inferior in respect of dependability etc. an angle of visibility, brightness, color reproduction nature, and over a long period of time as compared with CRT and the manufacturing cost has also become about 15 times from 3 times of CRT, the various methods about a liquid crystal display are proposed from many companies or the research facilities of a university for the improvement.
[0005] As the liquid crystal display of the conventional transparency mold active-matrix mold has the active-matrix substrate of translucency and shows it to this active-matrix substrate at drawing 11 , two or more pixel electrode 51 -- for impressing an electrical potential difference to a liquid crystal layer is formed in the shape of a matrix. As an active element which is a switching means for carrying out the selection drive of this pixel electrode 51 --, thin film transistor (TFT is called hereafter) 52 -- is formed in the above-mentioned active-matrix substrate, and is connected to pixel electrode 51 --. Although not illustrated, in addition to the above-mentioned configuration, in the case where color display is furthermore performed, red and which green and blue color filter layer are prepared on the above-mentioned active-matrix substrate or the opposite substrate on the substrate.
[0006] Scanning-line 53 -- is connected to the gate electrode in above-mentioned TFT52 --, and signal-line 54 -- is connected to the source electrode, respectively. It is the pixel electrode 51 with which signal-line 54 -- was arranged in the shape of a matrix with above-mentioned scanning-line 53 --. -- It passes along a perimeter, and it is arranged so that it may intersect perpendicularly mutually. Drive control of TFT52 -- is carried out by inputting a gate signal through above-mentioned scanning-line 53 --. Moreover, above-mentioned signal-line 54 -- is minded, and it is TFT52. -- A data signal (status signal) is inputted into pixel electrode 51 -- through TFT52 -- at the time of a drive.
[0007] Furthermore, TFT52 -- Pixel electrode 51 -- and addition capacity 55-- are connected to the drain electrode. The counterelectrode which counters through an insulating layer to this addition capacity 55 -- is connected to common wiring 56 --, respectively. Addition capacity 55 -- is for holding the electrical potential difference impressed to a liquid crystal layer.
[0008] In the liquid crystal display of a active-matrix mold, the liquid crystal layer is pinched between the above-mentioned active-matrix substrate and the opposite substrate which counters this. The

thickness of this liquid crystal layer is set as about 4.5-5.3 micrometers on the average. That is, a liquid crystal layer will be pinched between pixel electrode 51 -- formed on the active-matrix substrate, and the counterelectrode currently formed on the opposite substrate, and will form liquid crystal capacity. Above-mentioned addition capacity 55 -- is connected so that it may become in parallel with the above-mentioned liquid crystal capacity.

[0009] As shown in drawing 12 , the gate electrode 62 is formed on the transparent insulating substrate 61, and if said TFT52 is explained in more detail, gate dielectric film 63 is formed so that this may be covered. The semi-conductor thin film 64 is formed in the upper part of the gate electrode 62 through gate dielectric film 63. The channel protective layer 65 is formed in the central upper part of this semi-conductor thin film 64. Source electrode 66a which is from a microcrystal n+-silicon layer on the source section side of this channel protective layer 65 and the semi-conductor thin film 64 is formed, and drain electrode 66b which consists of a microcrystal n+-silicon layer as well as a drain section side is formed.

[0010] Metal layer 67a which becomes source wiring to the above-mentioned source electrode 66a is connected, and metal layer 67b which becomes drain wiring to drain electrode 66b is connected. This front face of TFT52 is covered with the interlayer insulation film 68, and the transparence electric conduction film used as the pixel electrode 51 is further formed on it. The pixel electrode 51 is connected with metal layer 67b used as drain wiring of TFT52 through the contact hole 69. Moreover, although not illustrated, on the pixel electrode 51, the orientation film for carrying out orientation of the liquid crystal is formed all over the viewing area at about 1 appearance.

[0011] As the above-mentioned interlayer insulation film 68, inorganic thin films, such as SiN, are used conventionally. The above-mentioned SiN film is CVD (Chemical Vapor Deposition). It can form in about 300nm or more of thickness by using law.

[0012] The liquid crystal molecule used as the above-mentioned liquid crystal layer here has refractive-index anisotropy deltan, further, this liquid crystal molecule inclined to the active-matrix substrate and opposite substrate which are pinching the liquid crystal molecule, in order to carry out orientation, the contrast of a display image changed with the directions and include angles which an observer looks at, and the trouble that a viewing-angle dependency becomes large is produced.

[0013] The liquid crystal display method of the Twisted Nematic (it is hereafter described as TN) mold which may be in the liquid crystal display of a pneumatic mold, and is used about the above-mentioned trouble is explained. For example, if the electrical potential difference of a halftone display is impressed to the liquid crystal display component 71 of TN mold as shown in drawing 13 , the liquid crystal molecule 72 will be in the condition of having started a little. At this time, the include angles at which the linearly polarized light 75 which passes through the direction of a normal of 73-substrate 74 front face, and the linearly polarized light 76-77 passed with an inclination to the direction of a normal cross the liquid crystal molecule 72 will differ in this liquid crystal display component 71, respectively. Since refractive-index anisotropy deltan exists in the liquid crystal molecule 72 as mentioned above, if the linearly polarized light 75-76-77 of each above-mentioned direction passes the liquid crystal molecule 72, forward Tsunemitsu and abnormality light will occur. In connection with the phase contrast of these forward Tsunemitsu and abnormality light, the above-mentioned linearly polarized light 75-76-77 will be changed into elliptically polarized light, respectively, and this serves as a generation source of a viewing-angle dependency.

[0014] Furthermore, inside an actual liquid crystal layer, the liquid crystal molecule 72 is in the condition that tilt angles differ near near the pars intermedia of a substrate 73 and a substrate 74, the substrate 73, or the substrate 74, and 90 degrees of liquid crystal molecules 72 can be twisted centering on the direction of a normal. With the direction and include angle, the linearly polarized light 75-76-77 which passes a liquid crystal layer by the above thing will receive various birefringence effectiveness, and will show a complicated viewing-angle dependency, respectively.

[0015] If the viewing angle is specifically leaned in the direction of a stigmatism angle which is down [of a screen] from the screen normal as the above-mentioned viewing-angle dependency as shown in drawing 14 , the phenomenon (henceforth a "coloring phenomenon") which a display image colors above a certain include angle, and the phenomenon (henceforth "reversal") which black and white

reverse will occur. Moreover, if a viewing angle is leaned in the direction of a reverse-sight angle which is above [of a screen] and it goes to it, contrast will fall rapidly.

[0016] In addition, in the above-mentioned liquid crystal display, there is also a problem that an angle of visibility becomes narrow as the display screen becomes large. If a big liquid crystal display screen is seen from a transverse plane in a near distance, the colors displayed in the upper part and the lower part of a screen for the effect of a viewing-angle dependency may differ. This is because a chance [of seeing the whole screen] angle becomes large and it becomes the same thing as seeing a liquid crystal display screen from the direction of slanting more.

[0017] In order to improve such a viewing-angle dependency, inserting the phase contrast plate (phase contrast film) as an optical element which has an optical anisotropy between a liquid crystal display component and one polarizing plate is proposed (for example, reference, such as JP,55-600,A).

[0018] By passing the phase contrast plate which made the light changed into elliptically polarized light from the linearly polarized light as mentioned above placed between one side or the both sides of a liquid crystal layer, this approach compensates the phase contrast of the forward Tsunemitsu and abnormality light which are produced in a viewing angle, reconverts it in the light of the linearly polarized light, and enables an improvement of a viewing-angle dependency. However, by this approach, it is necessary to set up also about a property, not only a phase contrast plate but a liquid crystal layer, i.e., a liquid crystal display component, and, moreover, the improvement effect of sufficient viewing-angle dependency cannot be acquired.

[0019] Then, in order to improve a viewing-angle dependency more, the one direction of the principal indices of refraction in an index ellipsoid receives this using an parallel thing to the direction of a normal of the front face of the above-mentioned phase contrast plate as the above-mentioned phase contrast plate. What takes the configuration which has the value of retardation (retardation) deltan-d which is the product of refractive-index anisotropy deltan of a liquid crystal ingredient and thickness d of a liquid crystal layer as a liquid crystal display component in the range of 200 to 500nm is used. The liquid crystal display which makes the above-mentioned phase contrast plate intervene between this liquid crystal display component and polarizing plate is proposed (JP,5-313159,A).

[0020] This approach makes it possible it not only to set up the property of a phase contrast plate and a liquid crystal display component, but to take the configuration set up so that the direction of rubbing of the orientation film which forms a liquid crystal display component, the direction of a lagging axis of a phase contrast plate, and the transparency shaft orientation of a polarizing plate may be parallel, respectively, and to improve a viewing-angle dependency further by this. However, even when such a phase contrast plate is used, the reversal of the direction of a stigmatism angle is seen at a narrow include angle.

[0021] Furthermore, the approach using that toward which the direction of the principal indices of refraction of an index ellipsoid inclines to the direction of a normal of the front face of a phase contrast plate as the above-mentioned phase contrast plate is also proposed (JP,6-75116,A, JP,8-50206,A, etc.). By this approach, two kinds of things as follows are used as a phase contrast plate.

[0022] The direction of one of the minimum principal indices of refraction is parallel to a front face among the three principal indices of refraction of an index ellipsoid. And one direction of remaining two principal indices of refraction inclines at an angle of theta to the front face of a phase contrast plate, the direction of another side inclines at an angle of theta similarly to the direction of a normal of a phase contrast plate front face, and the value of this theta is the phase contrast plate which is filling 20 degrees <= theta<=70 degrees.

[0023] The principal indices of refraction [in / another does not have a refractive-index anisotropy into the front face of a phase contrast plate, and / the direction of a surface normal of a phase contrast plate] nb, and the principal indices of refraction na parallel to the front face of a phase contrast plate, It is that in which nc fills the relation of na=nc>nb, namely, has optically uniaxial [negative]. The principal indices of refraction nb furthermore, by rotating a clockwise rotation or a counterclockwise rotation to the condition of having inclined from the condition parallel to the direction of a normal of a phase contrast plate front face centering on the above-mentioned phase contrast plate front face and one side of

the principal indices of refraction na and nc which make parallel It is the phase contrast plate with which the above-mentioned index ellipsoid inclined.
[0024] About two kinds of above-mentioned phase contrast plates, the former can use an optically uniaxial thing and an optically biaxial thing, respectively. moreover, the principal indices of refraction [in / the latter not only uses one phase contrast plate, but sees these a set of two phase contrast plates, and / the direction of a normal of a phase contrast plate front face] nb -- what was set up so that each above-mentioned inclination direction might make the include angle of 90 degrees mutually can be used.

[0025] in the liquid crystal display constituted by making such at least one or more phase contrast plates intervene between a liquid crystal display component and a polarizing plate, the until improvement of the viewing-angle dependency can be carried out to some extent. As shown in drawing 15 as the example, compared with drawing 14 , contrast is improved mostly in an omnidirection, and reversal of the direction of a stigmatism angle is also improved to about 35 degrees.
[0026] Furthermore, the structure which forms in one pixel electrode field the field where a tilt angle differs from an orientation condition as an improvement means of another viewing-angle dependency is also proposed (JP,5-210099,A, JP,7-64096,A, etc.). according to this, a until viewing-angle dependency can be made to improve to some extent
[0027] Furthermore, the method called an IPS (In Plane Switching) method as a liquid crystal display of new structure is developed, and fertilization is progressing (the patent number No. 2701698 official report, the patent number No. 2701832 official report). This method impresses electric field almost in parallel with the field inboard of a liquid crystal display substrate, and they carry out image display by controlling the sense of the liquid crystal molecule of each pixel. In the liquid crystal display method with which the present utilization is progressing, a viewing-angle property can realize the best liquid crystal display, and this method is being put in practical use centering on monitors, such as a computer.
[0028] Moreover, the liquid crystal display of a configuration of having formed the signal line in the opposite substrate side is proposed as the liquid crystal display of a configuration of having been shown in drawing 11 and drawing 12 , and a liquid crystal display of a configuration of differing from the above-mentioned.IPS method liquid crystal display (JP,5-27264,A, JP,7-128687,A, etc.). As this liquid crystal display is shown in drawing 16 , the liquid crystal layer 83 is formed in the gap of the pixel substrate 85 and the opposite substrate 84, TFT87 --, scanning-line 81--, pixel electrode 86--, and datum-line 88-- are formed on the pixel substrate 85, and signal-line 82 -- is formed on the opposite substrate 84. Thus, since it has the composition that signal-line 82 -- was formed on the respectively different substrate with scanning-line 81 --, possibility with signal-line 82 -- that a short circuit defect will arise in between becomes that there is nothing with scanning-line 81 --. Therefore, the yield can be improved.

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, the liquid crystal display concerning invention of claim 1 A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines and the above-mentioned orientation film is the configuration of having two or more orientation fields where orientation processing different, respectively was performed, in each pixel field corresponding to each above-mentioned pixel electrode.
[0135] Thereby, the problem of generating, such as a short circuit defect of a signal line and the scanning line and an open-circuit defect a level difference becomes large by forming wiring on a substrate over a multilayer, and according to this, is solved, and the effectiveness that the yield can be improved is done so.
[0136] Moreover, since it becomes the configuration which can raise dependability and does not have a big level difference since the defect which a crack produces in the interlayer insulation film with which each wiring is insulated, and is generated in it under the effect of membrane formation residual stress etc. can also be abolished, the effectiveness that generating of the optical leakage by poor orientation processing can also be controlled is done so.

[0137] Moreover, the effectiveness that the yield can be raised is done so rather than it forms the scanning line and a signal line on the same substrate.
[0138] Moreover, since compaction of production time can be aimed at, the effectiveness that compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at is done so.
[0139] Moreover, since the scanning line and a signal line are not close, load-carrying capacity added to each wiring can be made small, and this does so the effectiveness that signal delay can be reduced.
[0140] Furthermore, to the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle, since it has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle In case the weak spot of a mutual method can be compensated and light passes a liquid crystal layer, phase contrast change produced according to a viewing angle is compensated efficiently, and the effectiveness that an angle of visibility is improvable with sufficient balance over an omnidirection is done so.
[0141] The liquid crystal display concerning invention of claim 2 is the configuration that the above-mentioned orientation film has the orientation field which becomes good [a viewing angle] in each above-mentioned pixel field to the orientation field where a viewing angle becomes good to which above or down or an one direction, and another direction of above or down.
[0142] the effectiveness according to the configuration of claim 1 by this -- in addition, since the viewing-angle dependency of the direction of a stigmatism angle can be improved still more effectively, the effectiveness that balance is much more good and an angle of visibility can be improved to an omnidirection is done so by combining with the above-mentioned phase contrast plate usage.
[0143] The liquid crystal display concerning invention of claim 3 is a configuration set up so that the direction where the liquid crystal molecule near the orientation film inclines when an electrical potential difference is impressed to a pixel electrode, and the inclination direction of the above-mentioned index ellipsoid may become opposite in the orientation field of the largest area in each above-mentioned pixel field.
[0144] Thereby, since the bias of the inclination direction of a liquid crystal molecule can be compensated with a phase contrast plate in addition to the effectiveness by the configuration of claim 1, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the effectiveness that the good display image which is not crushed black can be obtained is done so. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained, in addition the effectiveness that the tone reversal phenomenon of a longitudinal direction can also be controlled is done so.
[0145] The liquid crystal display concerning invention of claim 4 is the configuration that the boundary of the above-mentioned orientation fields is arranged in the location corresponding to wiring which the above-mentioned scanning line consists of metals of protection-from-light nature, and consists of metals of the above-mentioned scanning line and/or protection-from-light nature.
[0146] Thereby, without lowering a numerical aperture in addition to the effectiveness by the configuration of claim 1, the optical leak by the poor liquid crystal orientation in the boundary of orientation fields can be covered, and the effectiveness that display grace can be raised is done so.
[0147] Two or more orientation fields where, as for the liquid crystal display according to claim 5, orientation processing from which it differs in each above-mentioned pixel field, respectively was performed are configurations prepared only in the orientation film on the above-mentioned pixel substrate.
[0148] Thereby, in case the boundary of orientation fields is covered with the scanning line and/or other wiring in addition to the effectiveness by the configuration of claim 4, alignment with the boundary of orientation fields, the scanning line, and/or other wiring can be performed with a sufficient precision, and the effectiveness that generating of defects, such as an optical leak, can be reduced is done so.
[0149] The manufacture approach of the liquid crystal display concerning invention of claim 6 A pixel

substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines. The above-mentioned orientation film Are the manufacture approach of a liquid crystal display of having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode, and the above-mentioned orientation film is received. It has rubbing down stream processing which performs orientation processing by rubbing processing, and optical exposure down stream processing which performs orientation processing which is different to each orientation field, respectively by irradiating light to the above-mentioned orientation film using the pattern mask corresponding to each above-mentioned orientation field.

[0150] Thereby, the rubbing processing which production conditions were established and is stable performs overall orientation processing, and the optical exposure is performing only control of a delicate orientation condition. Therefore, since the fault of both methods is suppliable, the effectiveness of becoming possible to be stabilized and to mass-produce a quality liquid crystal display is done so.

[0151] The above-mentioned orientation field is set up for the manufacture approach of the liquid crystal display concerning invention of claim 7 in [two] each above-mentioned pixel field, and the above-mentioned optical exposure process is performed only to one of the above-mentioned orientation fields.

[0152] In addition to the effectiveness by the approach of claim 6, this does so the effectiveness that the problem of the orientation processing defect by surroundings lump of the light accompanying the orientation processing by the exposure of light etc., the problem of the durable dependability of the orientation processing field by the exposure of light, etc. can be made into the minimum. Moreover, to coincidence, since the exposure process of light can be lessened, the effectiveness that reduction of a manufacturing cost can be aimed at is done so.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] however, SiNX which is a transparence insulator layer as an interlayer insulation film 68 in the liquid crystal display of a configuration of having been shown in drawing 11 and drawing 12 , SiO2, and TaOX etc. -- when membranes are formed by the CVD method or the spatter, the irregularity on front faces, such as metal layer 67a and 67b used as a substrate, and the channel protective layer 65, will be reflected on an interlayer insulation film 68. For this reason, since a bigger level difference will be formed based on the level difference of various kinds of film used as a substrate when pixel electrode 51 -- is formed on an interlayer insulation film 68, the trouble of causing the poor orientation (disclination) of a liquid crystal molecule has been produced.
[0030] Moreover, it is the pixel electrode 51 arranged in the shape of a matrix on the transparence substrate 61 whose signal-line 54 -- is the same substrate with scanning-line 53 --. -- It passes along a perimeter, and it is arranged so that many lines may cross mutually, respectively. Namely, the scanning line [-- The laminating will be carried out.] 53 -- Signal line 54 -- At each intersection, it is the scanning line 53. -- The level difference configuration is reflected upwards and it is a signal line 54.
[0031] For this reason, the trouble as shown in following ** - ** is invited.
[0032] ** In each above intersection, a crack tends to go into an interlayer insulation film 68, and it is easy to disconnect upper signal-line 54 -- during manufacture. Or by the pinhole in an interlayer insulation film 68, it is easy to short-circuit upper signal-line 54 -- and lower layer scanning-line 53--, they have become, and have lowered the yield.
[0033] ** In each above-mentioned intersection, under the effect of membrane formation residual stress etc., a new crack may arise with time, or the crack produced at the time of membrane formation may spread, a defect occurs after commercialization by this, and dependability falls.
[0034] ** In each above-mentioned intersection, since a big level difference is formed especially, when orientation processing (rubbing processing) of the orientation film is confused or the electric field from signal-line 54 -- work to nearby liquid crystal strongly, it is easy to produce leakage of light.
[0035] ** Since signal-line 54 -- is formed with scanning-line 53 -- on the same substrate, the yield at the time of manufacturing this substrate becomes about equal to what multiplied the yield of the process which forms scanning-line 53 --, and the yield of the process which forms signal-line 54 --, and will cause the fall of the further yield. Although there is relation with other processes and it cannot discuss simply about this point, if it thinks as a certain amount of standard For example, if the yield of the process which forms signal-line 54 -- for the yield of the process which forms scanning-line 53 -- 80% is made into 90% The yield at the time of manufacturing scanning-line 53 -- and the substrate with which signal-line 54 -- was formed becomes 72%, and it will fall rather than the yield at the time of forming scanning-line 53 -- or signal-line 54--.
[0036] ** Since scanning-line 53 -- and signal-line 54-- are formed on the same substrate, it needed to let each process pass in order, and increase of production time has been caused.
[0037] ** It will be necessary with enlargement or highly-minute-izing of a liquid crystal display to narrow the need for scanning-line 53 -- and signal-line 54-- of enlarging die length, and its width of face. By this, the load-carrying capacity in scanning-line 53 -- and signal-line 54-- increases, and delay of a

signal arises.
[0038] ** As explained referring to drawing 13 , the display using liquid crystal essentially has a narrow angle of visibility.
[0039] Moreover, with the configuration indicated by above-mentioned JP,5-313159,A, although the viewing-angle dependency of the display screen is improvable to a certain specific direction, it cannot improve about an omnidirection but there is a limitation.
[0040] Furthermore, there is a limitation in improving the reversal of the direction of a stigmatism angle especially with the configuration indicated by above-mentioned JP,6-75116,A. Moreover, in the configuration given in above-mentioned JP,8-50206,A improved rather than the configuration indicated by this JP,6-75116,A, although the viewing-angle property of a longitudinal direction and the direction of a reverse-sight angle improves sharply, the tone reversal of the direction of a stigmatism angle does not fully improve.
[0041] Furthermore, the configuration by the division orientation of JP,7-64096,A is not enough as an improvement of the viewing-angle property of a longitudinal direction or the direction of a reverse-sight angle, although the viewing-angle property of the vertical direction is equalized and the reversal of the direction of a stigmatism angle improves sharply.
[0042] Moreover, no configurations indicated by these JP,5-313159,A, JP,6-75116,A, JP,8-50206,A, and JP,7-64096,A are recognized about the technical problem of ** term from **, although it is effective in the technical problem of the above-mentioned ** term to some extent.
[0043] Moreover, although the structure differs from the configuration which showed the configuration by the above-mentioned IPS method to drawing 11 , drawing 12 , etc., the technical problem of ** term from above ** is not canceled. And since electrode structure serves as the complicated configuration where it entered in the same fields, such as the shape of a sinking comb, the numerical aperture of a picture element part is low. Therefore, in using for a monitor etc., in order to obtain required brightness (for example, transverse-plane brightness 200 cd/m2 extent), it will be necessary to increase the number of the light sources to 1.5 or more times over the past. Therefore, the weight and the dimension of a liquid crystal display increase and power consumption also becomes large. Moreover, in connection with the output of the light source becoming large, the temperature rise of the liquid crystal display itself becomes high, and there is also a possibility of reducing dependability. Thus, with portable information machines and equipment and the energy-saving goods which considered the environment, it can be said that it is difficult to use the liquid crystal display of such an IPS method. Furthermore, the liquid crystal display of an IPS method is not suitable for the product which needs the angle of visibility of the specific direction, for example like an individual humanity news device which makes the display screen hard to see to a surrounding man.
[0044] Moreover, to the technical problem of the above-mentioned ** term, the configuration proposed by above-mentioned JP,5-27264,A, JP,7-128687,A, etc. is not recognized about the technical problem of ** term from **, although it is effective. Moreover, sufficient viewing-angle property is not acquired with this configuration.
[0045] It is in offering the liquid crystal display which it was made in order that this invention might solve the above-mentioned trouble, and the purpose reduced the short circuit and open-circuit defect of each wiring of the scanning line, a signal line, etc., and raised the manufacture yield, and has improved the viewing-angle dependency, and its manufacture approach.

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MEANS

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, a liquid crystal display according to claim 1 A pixel substrate and the opposite substrate which sets a gap between the above-mentioned pixel substrates, and is countered and arranged between, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned.two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines and the above-mentioned orientation film is characterized by having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode.
[0047] With the conventional configuration, on the same substrate, the laminating of a signal line and the scanning line was carried out, they were formed, thereby, the level difference became large the short circuit defect of a signal line and the scanning line, and by forming wiring on a substrate over a multilayer, and the problem of generating, such as an open-circuit defect by this, had arisen. However, since according to the above-mentioned configuration a signal line is formed on an opposite substrate and the scanning line is formed on the pixel substrate, it is canceled and the above problems can improve the yield.
[0048] Moreover, since the defect which a crack produces in the interlayer insulation film with which each wiring is insulated, and is generated in it under the effect of membrane formation residual stress

etc. can also be abolished, dependability can be raised. Moreover, since it becomes a configuration without a big level difference, generating of the optical leakage by poor orientation processing can also be controlled.

[0049] Moreover, since the scanning line and a signal line are formed on a respectively different substrate, they can be manufactured combining the excellent article of a mutual substrate, and thereby, they can raise the yield rather than it forms the scanning line and a signal line on the same substrate. If it thinks simply, the yield at the time of, for example, manufacturing the yield of the formation process of the scanning line combining these, when the yield of the formation process of 80% and a signal line is made into 90% will become 80%. On the other hand, the manufacture yield becomes 72% when the scanning line and a signal line are formed on the same substrate. That is, the number of excellent articles can be made to raise a little more than ten percent.

[0050] Moreover, since it is formed on a substrate with respectively different the scanning line and a signal line, the parallel mode of each process can be carried out separately, and compaction of production time can be aimed at. In connection with this, compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at.

[0051] Moreover, since the scanning line and a signal line are not close, load-carrying capacity added to each wiring can be made small, and, thereby, signal delay can be reduced.

[0052] Furthermore, according to the above-mentioned configuration, the phase contrast plate is set up so that the index ellipsoid may incline, and the orientation film has two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each pixel electrode. That is, the liquid crystal display concerning this invention has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle at the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle. In case the weak spot of a mutual method can be compensated by this and light passes a liquid crystal layer, phase contrast change produced according to a viewing angle can be compensated efficiently, and an angle of visibility can be improved with sufficient balance over an omnidirection.

[0053] Moreover, the product including a special viewing-angle article of many forms can be manufactured easily, without converting a production line, for example, if each design condition of the above-mentioned phase contrast plate usage and an orientation split plot experiment is changed into according to, respectively.

[0054] The liquid crystal display according to claim 2 is characterized by the above-mentioned orientation film having the orientation field where a viewing angle becomes good to which above or down or an one direction in each above-mentioned pixel field, and the orientation field which becomes good [a viewing angle] to another direction of above or down in the configuration according to claim 1.

[0055] According to the above-mentioned configuration, in each pixel field, since the orientation film has the orientation field where a viewing angle becomes good to which above or down or an one direction, and the orientation field where a viewing angle becomes good to another direction of above or down, it can improve the viewing-angle dependency of the direction of a stigmatism angle still more effectively. Therefore, by combining with the above-mentioned phase contrast plate usage, balance is much more good and an angle of visibility can be improved to an omnidirection.

[0056] The liquid crystal display according to claim 3 is characterized by being set up so that the direction where the liquid crystal molecule near the orientation film inclines when an electrical potential difference is impressed to a pixel electrode, and the inclination direction of the above-mentioned index ellipsoid may become opposite in the configuration according to claim 1 in the orientation field of the largest area in each above-mentioned pixel field.

[0057] Also in the condition that the electrical potential difference was impressed to the pixel electrode, under the effect of orientation, the standup is weak and the bias of the inclination direction of a liquid crystal molecule has produced the liquid crystal molecule near the orientation film in the thickness

direction of a liquid crystal layer. In this point, in the orientation field of the largest area in each pixel field, since the optical property by the liquid crystal molecule and the optical property of a phase contrast plate are set up conversely, according to the above-mentioned configuration, the bias of the inclination direction of the above-mentioned liquid crystal molecule can be compensated with a phase contrast plate. Therefore, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the good display image which is not crushed black can be obtained. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained. In addition, the tone reversal phenomenon of a longitudinal direction can also be controlled.

[0058] In the configuration according to claim 1, the above-mentioned scanning line consists of metals of protection-from-light nature, and the liquid crystal display according to claim 4 is characterized by arranging the boundary of the above-mentioned orientation fields in the location corresponding to the above-mentioned scanning line and/or wiring which consists of metals of protection-from-light nature.

[0059] Without lowering a numerical aperture, since the boundary of orientation fields is arranged in the location corresponding to the scanning line which consists of a metal of protection-from-light nature, and/or other wiring according to the above-mentioned configuration, the optical leak by the poor liquid crystal orientation in the boundary of orientation fields can be covered, and display grace can be raised. Moreover, although the protection-from-light section was formed a little width in consideration of the lamination error of a pixel substrate and an opposite substrate when the protection-from-light section was formed also, for example on an opposite substrate, since such the protection-from-light section can be made into the minimum according to the above-mentioned configuration, a numerical aperture can be gathered further and display grace can be raised.

[0060] It is characterized by establishing two or more orientation fields where orientation processing from which it differs [in / on a configuration according to claim 4 and / in a liquid crystal display according to claim 5 / each above-mentioned pixel field], respectively was performed only in the orientation film on the above-mentioned pixel substrate.

[0061] Since an orientation field, and the scanning line which consists of a metal of protection-from-light nature and/or other wiring are prepared on the same pixel substrate according to the above-mentioned configuration, in case the boundary of orientation fields is covered with the scanning line and/or other wiring, alignment with the boundary of orientation fields, the scanning line, and/or other wiring can be performed with a sufficient precision. Therefore, generating of defects, such as an optical leak, can be reduced. Moreover, since it is not necessary to prepare two or more orientation fields where different orientation processing was performed to the orientation film on an opposite substrate, a manufacture process is simplified and the structure of an opposite substrate is stabilized. Therefore, the lamination of an opposite substrate and a pixel substrate is stabilized and deterioration of the display grace by gap of this lamination can be suppressed.

[0062] The opposite substrate which the manufacture approach of a liquid crystal display according to claim 6 sets a gap between a pixel substrate and the above-mentioned pixel substrate, and is countered and arranged, The liquid crystal layer pinched by the gap of the above-mentioned pixel substrate and the above-mentioned opposite substrate, and the pixel electrode prepared in the shape of a matrix on the above-mentioned pixel substrate, [two or more] In the counterelectrode prepared on the above-mentioned opposite substrate corresponding to the above-mentioned pixel electrode, and the above-mentioned pixel substrate and the above-mentioned opposite substrate In the above-mentioned orientation film [which was formed in the field facing the above-mentioned liquid crystal layer], and pixel substrate top In the above-mentioned two or more scanning-lines and two or more datum lines, and opposite substrate top [which have been arranged so that it may become parallel mutually in the border area of the above-mentioned pixel electrodes] In the above-mentioned signal-line [which has been arranged towards intersecting perpendicularly with the above-mentioned scanning line, and was connected to the above-mentioned counterelectrode], and pixel substrate top The switching element of the above-mentioned scanning line, the above-mentioned datum line, and 3 terminal molds by which the above-mentioned pixel electrode was connected to each terminal, The polarizing plate of the pair

arranged on each outside of the above-mentioned pixel substrate and the above-mentioned opposite substrate, Have the phase contrast plate by which it is placed between one side or both between the above-mentioned pixel substrate and the above-mentioned polarizing plate and between the above-mentioned opposite substrate and the above-mentioned polarizing plate, and it sets to the above-mentioned phase contrast plate. It sets in a representation layer at least. The three principal indices of refraction na and nb of an index ellipsoid, nc has relation called na=nc>nb, and one side of the principal indices of refraction na and nc is parallel to the front face of a phase contrast plate, and it centers upon the direction of the principal indices of refraction which make the parallel. By making a clockwise rotation or a counterclockwise rotation rotate the principal indices of refraction nb to the condition of having inclined from the condition parallel to the direction of a normal of the front face of a phase contrast plate The above-mentioned index ellipsoid inclines. The above-mentioned orientation film Are the manufacture approach of a liquid crystal display of having two or more orientation fields where orientation processing different, respectively was performed in each pixel field corresponding to each above-mentioned pixel electrode, and the above-mentioned orientation film is received. By irradiating light to the above-mentioned orientation film using rubbing down stream processing which performs orientation processing, and the pattern mask corresponding to each above-mentioned orientation field by rubbing processing It is characterized by having optical exposure down stream processing which performs orientation processing different, respectively to each orientation field.

[0063] According to the above-mentioned approach, rubbing processing by which stable production is carried out by a certain amount of yield, and orientation processing by irradiating light using a pattern mask are performed from the former. That is, the rubbing processing which production conditions were established and is stable performs overall orientation processing, and the optical exposure is performing only control of a delicate orientation condition. Therefore, since the fault of both methods is suppliable, it becomes possible to be stabilized and to mass-produce a quality liquid crystal display.

[0064] In the approach according to claim 6, the above-mentioned orientation field is set up for the manufacture approach of a liquid crystal display according to claim 7 in [two] each above-mentioned pixel field, and the above-mentioned optical exposure process is characterized by being carried out only to one of the above-mentioned orientation fields.
 [0065] Since an optical exposure process is performed only to one of the above-mentioned orientation fields according to the above-mentioned approach, what is necessary will be to perform the exposure of light only once. Therefore, the problem of the orientation processing defect by surroundings lump of the light accompanying the orientation processing by the exposure of light etc., the problem of the durable dependability of the orientation processing field by the exposure of light, etc. can be made into the minimum. Moreover, to coincidence, since the exposure process of light can be lessened, reduction of a manufacturing cost can be aimed at.

[0066]

[Embodiment of the Invention] [Gestalt 1 of operation] It will be as follows if one gestalt of operation of this invention is explained based on drawing 1 thru/or drawing 8 .

[0067] The liquid crystal display 1 concerning this operation gestalt has composition equipped with the liquid crystal display component 5, phase contrast plate 2a and 2b which are arranged in contact with the field of the both sides of the liquid crystal display component 5, and the polarizing plate 3-4 arranged in contact with an outside field at the pan of phase contrast plate 2a and 2b, as shown in drawing 6 .

[0068] The above-mentioned liquid crystal display component 5 is equipped with the liquid crystal layer 12 pinched by enclosing a perimeter by the sealant 13 in the gap of the opposite substrate 6 which consists of a translucency substrate, the pixel substrate 7 which similarly consists of a translucency substrate, and the opposite substrate 6 and the pixel substrate 7.

[0069] The orientation film 10 which becomes signal-line 8 -- which consists of ITO (Indium Tin Oxide) etc. from polyimide, polyvinyl alcohol, etc., and two or more color filters (not shown) divided and arranged for every pixel are formed in the front face of the opposite substrate 6. Similarly, the orientation film 11 which becomes pixel electrode 9 -- which consists of ITO etc. from polyimide, polyvinyl alcohol, etc. is formed in the front face of the pixel substrate 7. Each pixel electrode 9 is arranged corresponding to the location of the color filter of each color formed on the opposite substrate

6.

[0070] Moreover, the light source 14 and a transparent material 15 are arranged on the outside by the side of the pixel substrate 7 in a liquid crystal display 1. A transparent material 15 is a plate of the magnitude of about same extent as the field of the liquid crystal display component 5, and the light source 14 is arranged in the long and slender configuration on the outside of the one side of a transparent material 15. Homogeneity distributes in a transparent material 15 and the light which carried out outgoing radiation from the light source 14 is irradiated all over the field equivalent to the display screen in a liquid crystal display 1. The configuration which doubled this light source 14, the transparent material 15, and the member of the circumference of it is called a back light unit.

[0071] In addition, in this operation gestalt, although only one LGT is arranged on the outside of the one side of a transparent material 15, the light source 14 can also be considered as the configuration which arranges two or more light source 14 -- also on the outside of other sides of a transparent material 15, and a configuration which the one light source 14 is made crooked and surrounds the perimeter of a transparent material 15, when the quantity of light needs to be raised more. Moreover, it is also possible to consider as the configuration in a transparent material 15 which arranges two or more light source 14 -- and the light source 14 made crooked with the liquid crystal display component 5 side on the outside of the field of the opposite side.

[0072] Rubbing processing is beforehand performed so that each front face of the orientation film 10-11 can be twisted at about 90 degrees and the intervening liquid crystal molecule may carry out orientation. As shown in drawing 2 , in the above-mentioned liquid crystal display component 5, rubbing processing is performed in the direction of an arrow head 21 to the orientation film 10 on the opposite substrate 6, and more specifically to the orientation film 11 on the pixel substrate 7, rubbing processing is performed so that it may become the direction of the arrow head 22 which intersects perpendicularly to an arrow head 21. In addition, the direction of an arrow head 21 and an arrow head 22 is hereafter called the direction 21 of rubbing, and the direction 22 of rubbing, respectively.

[0073] As shown in drawing 3 , the above-mentioned polarizing plate 3-4 is arranged so that each absorption shaft orientations 23-24 may intersect perpendicularly mutually. Therefore, when not impressing an electrical potential difference to the liquid crystal layer 12, the liquid crystal display 1 serves as the so-called normally white means of displaying which penetrates light and performs a white display. At this time, the absorption shaft orientations 23 of a polarizing plate 3 and the direction 21 of rubbing of the above-mentioned orientation film 10 are set up so that it may become parallel mutually. Moreover, similarly, the absorption shaft orientations 24 of a polarizing plate 4 and the direction 22 of rubbing of the above-mentioned orientation film 11 are set up so that it may become parallel mutually.

[0074] Here, in phase contrast plate 2a and 2b, the direction of the principal indices of refraction nb which incline in the direction which gives an anisotropy to this phase contrast plate 2a and 2b defines the direction projected on the front face of phase contrast plate 2a and 2b as main refraction projection direction 25aand25b, respectively. At this time, as shown in drawing 3 , main refraction projection direction 25a in phase contrast plate 2a and the direction 21 of rubbing of the orientation film 10 are set up so that it may become the same direction mutually in parallel. Similarly, main refraction projection direction 25b in phase contrast plate 2b and the direction 22 of rubbing of the orientation film 11 are set up so that it may become the same direction mutually in parallel.

[0075] In addition, the above-mentioned phase contrast plate 2a and 2b will become possible [compensating phase contrast], if at least one sheet intervenes between a polarizing plate 3 and a polarizing plate 4. Furthermore, phase contrast plate 2a or two or more phase contrast plate 2bs may intervene between a polarizing plate 3 and the liquid crystal display component 5 or between a polarizing plate 4 and the liquid crystal display component 5. in addition, between the liquid crystal display component 5 and both polarizing plates 3-4 -- phase contrast plate 2a and 2b -- respectively -- two or more sheets -- two or more sheets may intervene.

[0076] As for phase contrast plate 2a used for the above-mentioned liquid crystal display 1, as shown in drawing 4 , in a representation layer, three principal-indices-of-refraction na-nb-nc of an index ellipsoid has at least the relation of na=nc>nb, i.e., the relation from which a refractive-index anisotropy serves as

negative, on the average as the whole phase contrast plate 2a. Thereby, phase contrast plate 2a is equipped with optically uniaxial [in which one optical axis exists]. include-angle theta Moreover, a definition of the rectangular coordinate system xyz which makes the front face of the above-mentioned phase contrast plate 2a a x-y flat surface has inclined the direction of the principal indices of refraction nb in the direction of an arrow head A to the direction z-axis of a normal of the front face of phase contrast plate 2a. include-angle theta Furthermore, the principal indices of refraction nc also lean in the direction of an arrow head B to the direction of a x axis parallel to the front face of phase contrast plate 2a.

[0077] Namely, in phase contrast plate 2a, the index ellipsoid is in the condition of inclining at the include angle theta counterclockwise centering on the direction of the principal indices of refraction na, as a whole. The inclination of this index ellipsoid may incline clockwise centering on the direction of the principal indices of refraction na. In addition, since it is the configuration same also about phase contrast plate 2b as the above-mentioned phase contrast plate 2a, explanation is omitted.

[0078] With the gestalt of this operation, the inclination of the principal indices of refraction nb uses that whose above-mentioned include angle theta is about 20 degrees as phase contrast plate 2a and 2b. In the principal indices of refraction nc, at this time, the above-mentioned include angle theta is about 20 degrees similarly. That is, 20 degrees of index ellipsoids will incline counterclockwise centering on the direction of the principal indices of refraction na.

[0079] By setting the retardation value of the above-mentioned phase contrast plate 2a and 2b as a different value, the compensation function of phase contrast can be obtained certainly. As the above-mentioned retardation value, there are the 1st and 2nd retardation values. the 1st retardation value -- as the whole phase contrast plate 2a and 2b -- difference nc-na of the principal indices of refraction nc and the principal indices of refraction na, and thickness df of phase contrast plate 2a and 2b Product (nc-na) xdf it is . on the other hand, the 2nd retardation value -- difference nc-nb of the principal indices of refraction nc and the principal indices of refraction nb, and phase contrast plate 2a and thickness df of 2b Product (nc-nb) xdf it is .

[0080] With the gestalt of this operation, as phase contrast plate 2a and 2b, discotheque liquid crystal is applied to the transparent base materials (for example, triacetyl cellulose (TAC) etc.) of 80% or more of transmission, inclination orientation of the discotheque liquid crystal is specifically carried out, and that whose 2nd retardation value said 1st retardation value is 0nm, and is 100nm is used.

[0081] The discotheque liquid crystal by which inclination orientation is carried out to the above-mentioned phase contrast plate 2a and 2b forms the layer for the discotheque structure which is a disk configuration in a liquid crystal molecule as one structural unit. The tilt angle of the disk side in one unit of this discotheque structure and the front face of this phase contrast plate 2a and 2b to make is changing to continuation or discontinuity in the depth direction of this phase contrast plate 2a and 2b. As for the above-mentioned tilt angle, at this time, it is desirable that the average is 15 degrees - 75 degrees.

[0082] Since formation of the layer of the above-mentioned discotheque liquid crystal can be formed by the applying method as compared with the conventional manufacture approaches, such as an extension process type, phase contrast plate 2a and 2b can be easily manufactured by low cost.

[0083] And the manufacture approach of phase contrast plate 2a and 2b does not need to manage the homogeneity of tension like an extension process type, is easy, and low cost. From this, a large-sized product (for example, 20 inches or more) can also be manufactured with sufficient quality more easily than before. In addition, in this operation gestalt, the product marketed from Fuji Photo Film was used as phase contrast plate 2a and 2b.

[0084] Here, in the liquid crystal display using the conventional phase contrast plate, the trouble that the viewing-angle difference of the right and left in this display screen became large was produced, so that the display screen became large. Especially in the display screen where a screen size becomes 20 inches or more, supposing it saw the location where an observer separates from this display screen 50cm with a vertical distance, and a viewing angle serves as the above around 50 degrees to the core of this display screen to the display screen, it saw from the observer and the remarkable coloring phenomenon was observed in the edge of a far side.

[0085] When the above-mentioned vertical distance became small, the check include angle of the above-mentioned coloring phenomenon was still smaller from 50-degree order. Moreover, when the conventional display whose screen size is 15 inches was also 35cm in the above-mentioned vertical distance, the remarkable coloring phenomenon was too checked in the right-and-left viewing angle of about 50 degrees.
[0086] However, in addition to the ability to manufacture a large-sized phase contrast plate easily, the quality variation and debasement accompanying enlargement also decrease with the phase contrast plate constituted from discotheque liquid crystal which was mentioned above. For this reason, phase contrast plate 2a and 2b of high quality can be obtained conventionally.
[0087] therefore, in the liquid crystal display 1 of this operation gestalt Also in the liquid crystal display which has the large-sized display screen where a viewing-angle difference is easy to be recognized (1) A screen size with a small observation distance from a screen of a personal application A liquid crystal display 15 inches or more, (2) the screen size observed from an extensive viewing angle although the observation distance used as various monitors leaves a few as a monitor for a liquid crystal display 20 inches or more, (3) home use, business use, or OA the liquid crystal display from 20 inches or more to about 40 inches with the large-sized screen size which is required in recent years and is being developed -- it comes out, and even if it is, a high definition display is realizable.
[0088] Moreover, the tilt angle of the optical anistropic axis in this phase contrast plate 2a and 2b can change orientation processing, an ingredient, etc. of a substrate in the thickness direction of phase contrast plate 2a and 2b easily by choosing suitably at this time. It can add to optical compensation of phase contrast plate 2a and 2b for doubling with the property of the liquid crystal of the liquid crystal display component 5 by this, and optimal optical amendment can be easily performed according to the optical property of the configuration member by the side of the interior of the liquid crystal display component 5, and the exterior (liquid crystal side) (atmospheric-air side), for example, the refractive index which liquid crystal shows. Therefore, phase contrast plate 2a and 2b of the optimal structure can be obtained easily.
[0089] Although there was a little yellow taste of level with difficult discernment when the above-mentioned phase contrast plate 2a and 2b were used to the liquid crystal display 1 and the display screen was inspected visually for this from the direction 60 to 70 degrees or more right and left and a top, coloring and reversal serve as hardly worried extent, and the display beautiful enough was obtained.
[0090] Moreover, by repeating and applying discotheque liquid crystal to a transparent base material as the above-mentioned phase contrast plate 2a and 2b, and changing the inclined plane of the disk side of a discotheque liquid crystal structural unit in the thickness direction, hybrid orientation of the discotheque liquid crystal was carried out, and it used for the liquid crystal display 1 about the thing whose 2nd retardation value said 1st retardation value is 0nm, and is 100nm as well as the above.
[0091] Even in this case, when the display screen of a liquid crystal display 1 was inspected visually from the direction 60 to 70 degrees or more right and left and a top, coloring and reversal were not seen but the beautiful display was obtained.
[0092] Since it becomes possible since the phase contrast of the forward Tsunemitsu and abnormality light which are produced according to a viewing angle by using the above-mentioned phase contrast plate 2a and 2b is compensated with a large area with sufficient quality to change into the linearly polarized light over the range where a viewing angle is large and the coloring phenomenon and reversal accompanying viewing-angle change can be canceled, the liquid crystal display 1 with few viewing-angle dependencies can be obtained.
[0093] It is desirable that refractive-index anisotropy deltan (450) to light with a wavelength of 450nm and difference deltan(450)-delta[of refractive-index anisotropy deltan (650) to light with a wavelength of 650nm] n (650) use the liquid crystal set as or more 0 0.01 or less range as liquid crystal in the liquid crystal display 1 of this operation gestalt with the above-mentioned phase contrast plate 2a and 2b. In this case, the coloring from a slanting angle of visibility can be reduced more, and extent which does not worry the yellow taste near the angle-of-visibility limitation at all, either is solved.
[0094] In optical elements, such as the above-mentioned phase contrast plate 2a and 2b, and a polarizer

3-4, the refractive-index anisotropies over the wavelength of light usually differ in each part of this optical element. For example, although used as current phase contrast plate 2a and 2b, the refractive-index anisotropy of many is large at a short wavelength side, and it is small by the tidal-wave length side. For this reason, the phase contrast of the forward Tsunemitsu and abnormality light which are produced according to a viewing angle can be compensated still more effectively than before by using liquid crystal with the small difference of the refractive-index anisotropy by the side of short wavelength, and the refractive-index anisotropy by the side of tidal-wave length combining the above-mentioned phase contrast plate 2a and 2b.

[0095] As liquid crystal, using 0.07 and the liquid crystal ingredient which are 0.08 and 0.095, refractive-index anisotropy deltan (550) to light with a wavelength of 550nm set the cel thickness (thickness of the liquid crystal layer 12) of the liquid crystal display component 5 as about 4.5 micrometers, and, specifically, checked the good display with this operation gestalt. Since the smaller one tends to improve an angle-of-visibility property, cel thickness is developing the configuration which set current and cel thickness to about 3 micrometers.

[0096] Moreover, in the liquid crystal layer 12, as explained referring to drawing 2 and drawing 3 , where 90 degrees is twisted, orientation of the liquid crystal molecule is carried out. In addition, since the means of displaying of a normally white method is adopted, the display contrast, the color reproduction nature, and the viewing-angle dependency of the display screen can be raised more. Since white can be especially displayed more vividly by the normally white method, it is more desirable than a normally black method.

[0097] Next, the structure of the pixel substrate 7 with which the liquid crystal display 1 of this operation gestalt is equipped, and its front face is explained below.

[0098] Drawing 5 is the sectional view showing the outline of the structure of the pixel substrate 7 and its front face. On the pixel substrate 7, two or more TFT31 -- as a switching element is formed, and two or more pixel electrode 9 -- is further formed on it.

[0099] Above-mentioned TFT31 -- has the following composition. The gate electrode 32 is formed on the pixel substrate 7, and gate dielectric film 33 is formed so that this may be covered. The semi-conductor thin film 34 is formed in the upper part of the gate electrode 32 through gate dielectric film 33. Source electrode (contact layer) 35a which consists of a microcrystal n+ silicon layer is formed in the source section side of this semi-conductor thin film 34, and drain electrode 35b (contact layer) which similarly consists of a microcrystal n+ silicon layer is formed in the drain section side. Moreover, source wiring 36 is formed in the pan of source electrode 35a at the upper layer, and the drain wiring 37 is formed in the pan of drain electrode 35b at the upper layer. In addition, in this operation gestalt, the pixel electrode 9, source wiring 36, and the drain wiring 37 consist of same ingredients. Moreover, in order to attain simplification of a manufacture process, in the conventional configuration, the channel protective coat formed in the central upper part of the semi-conductor thin film 34 is not formed in this operation gestalt.

[0100] The pixel electrode 9 is connected to the source wiring 36 of the above TFT31, and the datum line 38 is connected to the drain wiring 37. In addition, drawing 5 is not necessarily drawing having shown the straight-line cross section.

[0101] Drawing 1 is the perspective view showing the outline configuration of the liquid crystal display component 5. As shown in drawing 1 , the pixel electrode 9 is divided into division picture element part 9a and 9b from which liquid crystal orientation differs, and the datum line 38 is running along it in the gap of division picture element part 9a and 9b. This division picture element part 9a and 9b are formed so that it may become surface ratio 17:3. Thus, viewing-angle dependence of the direction of a stigmatism angle is improvable by dividing the pixel electrode 9 into division picture element part 9a and 9b from which liquid crystal orientation differs.

[0102] Here, the surface ratio of division picture element part 9a and 9b is explained. When the surface ratio of division picture element part 9a and 9b is changed, if one side becomes good, property change which conflicted mutually that another side gets worse is shown by the tone reversal and contrast of the direction of a stigmatism angle.

[0103] When the above-mentioned surface ratio is 17:3, more specifically, both the limitation of the contrast in the direction of a stigmatism angle and the limitation of tone reversal become about 40 degrees. On the other hand, when the above-mentioned surface ratio is 19:1, the limitation of the tone reversal in the direction of a stigmatism angle is about 37-38 degrees, and improves rather than 35 degrees which is the limitation of the tone reversal of the conventional optical compensating plate method. Moreover, the limitation of contrast is sufficient viewing-angle limitation 55 degrees or more. Moreover, when the above-mentioned surface ratio is 6:4, as for the limitation of 20 degrees or more and tone reversal, the limitation of the contrast in the direction of a stigmatism angle is 50 degrees or more. In addition, the fall of contrast is seldom worried, when actually observing comparing with tone reversal.

[0104] As for the surface ratio of division picture element part 9a and 9b, it is more desirable than the above result to be set up in 6:4 to 19:1. When set up in such range, the balance of control of tone reversal and improvement in contrast becomes good. For example, when it is the liquid crystal display of a 20 inch screen size, in the direction of a stigmatism angle, a good display can be observed in the viewing angle of about 40 degrees by about 20 degrees and max at the lowest. In addition, in a longitudinal direction and the direction of a reverse-sight angle, a good display is observable in the viewing angle of 50-70 degrees at this time.

[0105] And division picture element part 9a and 9b are connected by pixel connection section 9c and 9c in the both ends of the gap of division picture element part 9a and 9b. Thus, since only pixel connection section 9cand9c are formed in the upper part of the datum line 38, generating of poor leak can be reduced, for example as compared with the case where the whole surface of the pixel electrode 9 is formed in the upper part of the datum line 38.

[0106] Scanning-line 32 -- and datum-line 38-- are formed by the monolayer or multilayer structure with the metallic material of protection-from-light nature, such as a tantalum, tantalum nitride, and aluminum.

[0107] In addition, the counterelectrode formed on the opposite substrate 6 corresponding to the pixel electrode 9 was formed with the same width of face and the same ingredient in this operation gestalt succeeding the signal line 10. However, as a large-sized liquid crystal display panel shows to drawing 7 , it is good also as the reduction in resistance of wiring resistance, and a configuration which connects the counterelectrode 39 which consists of transparence electric conduction film with the signal line 40 which consists of a metal membrane of protection-from-light nature thinner than it in order to improve the protection-from-light nature of unnecessary light.

[0108] The pre tilt angle given to a liquid crystal molecule is changed in each top face of the above-mentioned division picture element part 9a and 9b, or the orientation film 11 (not shown in drawing 1) is formed in it so that it may become the field to which orientation differs mutually with a method, such as making the direction of a tilt of a liquid crystal molecule into the opposite sense mutually in a field.

[0109] In each of division picture element part 9a and 9b, if the orientation art changed into a different orientation condition is carried out, one field is covered by a resist etc. and there are an approach of carrying out rubbing processing of another field, the approach of changing optical exposure conditions for every field, and carrying out orientation processing using the orientation processing by optical exposure, etc. In the case of the former approach, there are problems, like contamination and deterioration of the orientation processing section arise by processing at the time of the resist remainder whose percent defective by the static electricity destruction which a rubbing man day increases increases, and resist exfoliation etc. As for the orientation processing by optical exposure, in the case of the latter approach, mass production technology is not fully established. for example, the case where orientation conditions are mutually changed in the minute field which the durable dependability when adding the optical exposure supposing an outdoor natural light exposure was inadequate, or adjoined -- light -- turning -- being crowded -- etc. -- there is a problem of the poor orientation to depend occurring.

[0110] With this operation gestalt, first, to the orientation film 10-11, orientation processing by rubbing is performed, either division picture element part 9a or 9b are covered with a pattern mask after that, and, on the whole, the delicate orientation condition is adjusted by performing an optical exposure. With

this method, the good liquid crystal display component 5 of quality can be manufactured with sufficient productivity.

[0111] In this operation gestalt, it is each of the orientation film on division picture element part 9a, the orientation film on division picture element part 9b, and the orientation film by the side of the opposite substrate 6, and orientation processing was performed, respectively so that a pre tilt angle might become 5 degrees, 2 degrees, and about 3 degrees by the correlation sample. However, on an actual panel, a pre tilt angle is not uniform, and what inclines delicately and is distributed is conjectured by the effect of reflection of exposure light, a surroundings lump, etc.

[0112] Thus, by each of the orientation film on division picture element part 9a, the orientation film on division picture element part 9b, and the orientation film by the side of the opposite substrate 6, since orientation processing is performed so that pre tilt angles may differ, the pre tilt of the liquid crystal near the center section of the liquid crystal layer 12 is hard flow mostly mutually, and, thereby, a viewing-angle dependency is improved.

[0113] Moreover, in this operation gestalt, the direction where the liquid crystal molecule of a field with a larger area among division picture element part 9a and 9b (division picture element part 9a near [i.e.,]) inclines when an electrical potential difference is impressed with the pixel electrode 9, and the inclination direction of the index ellipsoid in phase contrast plate 2a and 2b are set up so that it may become an opposite direction mutually. This is explained in detail by the following.

[0114] Also in the condition that the electrical potential difference was impressed to the pixel electrode 9, under the effect of orientation, the standup is weak and the bias of the inclination direction of a liquid crystal molecule has produced the about 10-11 orientation film liquid crystal molecule in the thickness direction of the liquid crystal layer 12. According to the above-mentioned configuration, in this point, the bias of the inclination direction of the above-mentioned liquid crystal molecule can be compensated with phase contrast plate 2a and 2b. Therefore, when a viewing angle is leaned in the direction of a stigmatism angle, a tone reversal phenomenon is controlled and the good display image which is not crushed black can be obtained. Furthermore, the fall of contrast is controlled also in the direction of a reverse-sight angle, and the good display screen which does not wear white ** can be obtained. In addition, the tone reversal phenomenon of a longitudinal direction can also be controlled.

[0115] In addition, with this operation gestalt, orientation processing was performed by irradiating light only once to the orientation film which has the pre tilt angle of 2 degrees and 3 degrees among each orientation film with the pre tilt angle of 5 degrees, 2 degrees, and 3 degrees. Thereby, since the number of processes of orientation processing can be reduced, dispersion in a man day, a percent defective, and an orientation processing state etc. can be reduced.

[0116] Although a visible ray and infrared radiation were sufficient as the exposure light used in the case of this orientation processing, high energy was obtained easily and ultraviolet rays were used for it from the reason nil why dependability is comparatively stable etc. A high pressure mercury vapor lamp is used for exposure conditions, and they are 5000 mJ/cm2. It is the energy per unit area and the exposure was performed for 5 minutes.

[0117] Drawing 8 (a) thru/or (d) are the explanatory views showing the flow of orientation film formation down stream processing. As shown in drawing 8 (a) thru/or (d), at orientation film formation down stream processing, an orientation film spreading process, a baking process, a rubbing process, and a washing process are performed in this order. And the process (optical exposure process) which performs the further above-mentioned optical exposure is performed after a baking process (in the case of drawing 8 (b)) in either after a rubbing process or a washing process (in the case of drawing 8 (c)) (in the case of drawing 8 (d)) after an orientation film spreading process (in the case of drawing 8 (a)).

[0118] As mentioned above, in the liquid crystal display 1 concerning this operation gestalt, since signal-line 8 -- is formed on a respectively different substrate with scanning-line 32 --, it can manufacture combining the excellent article of a mutual substrate, and thereby, the yield can be raised rather than it forms signal-line 8 -- on the same substrate with scanning-line 32 --.

[0119] Moreover, since signal-line 8 -- is formed on a respectively different substrate with scanning-line 32 --, the parallel mode of each process can be carried out separately, and compaction of production

time can be aimed at. In connection with this, compaction of time for delivery and useless reduction made and stored (inventory) can be aimed at.

[0120] Moreover, since signal-line 8 -- is not close with scanning-line 32 --, load-carrying capacity added to each wiring can be made small, and, thereby, signal delay can be reduced. In addition, load-carrying capacity compares with scanning-line 32 -- with the configuration with signal-line 8 -- which forms the conventional scanning line and a conventional signal line on the same substrate although not necessarily prescribed by only the capacity of a between, and is the scanning line 32. -- They are 1/6 or less and a signal line 8 at a side. -- It checked by simulation that a time delay could be reduced or less to 1/4 by the side.

[0121] Moreover, the liquid crystal display 1 concerning this operation gestalt has composition which combined the orientation split plot experiment which has effectiveness in the improvement of a viewing-angle dependency to the direction of a stigmatism angle at the negative phase contrast plate usage of the principal-indices-of-refraction plunge mold which has effectiveness in the improvement of a viewing-angle dependency to right and left and the direction of a reverse-sight angle. In case the weak spot of a mutual method can be compensated by this and light passes the liquid crystal layer 12, phase contrast change produced according to a viewing angle can be compensated efficiently, and an angle of visibility can be improved with sufficient balance over an omnidirection.

[0122] [Gestalt 2 of operation] It will be as follows if other gestalten of operation of this invention are explained based on drawing 9 and drawing 10 . In addition, the same sign is appended to the configuration explained with the above mentioned gestalt 1 of operation, and the configuration which has the same function, and the explanation is omitted.

[0123] Drawing 9 is the perspective view showing the outline configuration of the liquid crystal display component in the liquid crystal display concerning this operation gestalt. Like the configuration in the gestalt 1 of operation, the liquid crystal layer 12 is pinched by the gap of the pixel substrate 7 and the opposite substrate 6, TFT31 --, scanning-line 32--, datum-line 38--, and pixel electrode 43-- are formed on the pixel substrate 7, and the signal line 8 is formed on the opposite substrate 6 by this liquid crystal display component.

[0124] The above-mentioned pixel electrodes 43 differ in the pixel electrode 9 in the gestalt 1 of operation, and have the composition that the division picture element part was not formed but the electrode was continuously formed also on the datum line 38.

[0125] Drawing 10 is the sectional view showing the cross-section structure of the above-mentioned liquid crystal display component. On the pixel substrate 7, scanning-line 32 -- and datum-line 38-- are formed, insulator layer 33 -- which consists of non-equipments is further formed on them, and scanning-line 32 -- and datum-line 38-- are protected firmly. Moreover, the interlayer insulation film 42 of a low dielectric constant of scanning-line 32 -- and the pixel substrate 7 with which datum-line 38 -- and insulator layer 33-- were formed is mostly formed in the whole surface. This interlayer insulation film 42 consists of organic materials in which flattening is possible.

[0126] Pixel electrode 43 -- is formed in the upper layer of this interlayer insulation film 42. By such structure, it is the pixel electrode 43. -- An edge can be superimposed in a part superficially [scanning-line 32 -- as a lower layer protection-from-light metal layer]. Therefore, since the numerical aperture of a pixel can be improved, improvement in brightness and reduction of the power consumption of a back light can be aimed at.

[0127] Moreover, since it is shaded by above-mentioned scanning-line 32 -- etc., the orientation turbulence of the surrounding liquid crystal of each pixel electrode 43 can make line breadth of the black matrix 47 small compared with the case where a protection-from-light pattern is arranged only to the opposite substrate 6. In the case where this arranges a protection-from-light pattern only for the opposite substrate 6, the black matrix 47 in the opposite substrate 6 is because the line breadth was set up width somewhat in consideration of the lamination error (about 5 micrometers) of the opposite substrate 6 and the pixel substrate 7. Moreover, it is also possible to consider as the design which protection from light by above-mentioned scanning-line 32 -- can perform completely, then the configuration which excluded the black matrix 47, and reduction of a production process and ingredient cost can be aimed at in this

case.
[0128] On the pixel electrode 43, orientation film 44a and 44b which changes the pre tilt angle of liquid crystal mutually are formed.
[0129] On the other hand, on the opposite substrate 6, red, green, and color filter layer 46 -- corresponding to each blue color are formed in the location corresponding to each pixel, and it is this color filter layer 46. -- Black matrix 47 -- which has a protection-from-light function is formed in the gap of comrades. Moreover, color filter layer 46 -- and the black matrix 47 -- The flattening protective coat 48 and signal-line 8 which also has function of counterelectrode in the upper layer further -- are formed at the upper layer. Furthermore, signal line 8 -- The orientation film 10 of the opposite substrate 6 mostly formed uniformly over the whole surface is formed in the upper layer.
[0130] In the liquid crystal layer 12 with which it filled up between the opposite substrate 6 and the pixel substrate 7, the liquid crystal near a center to the thickness direction is arranged with a mutually different tilt angle corresponding to each field of the above-mentioned orientation film 44a and 44b, when the electrical potential difference is not impressed. The viewing-angle dependency of the vertical direction is improved by this.
[0131] Here, the above-mentioned interlayer insulation film 42 is explained to a detail. As an ingredient which constitutes an interlayer insulation film 42, since a formation process becomes simple, photosensitive resin is desirable. Moreover, since the one where the parasitic capacitance in an interlayer insulation film 42 is smaller can perform a good display, an ingredient with a low dielectric constant is desirable. As a concrete ingredient, the diameter photopolymer of an acrylic, benz-cyclo-butene (Benzosyclobutene), or transparent and colorless polyimide is desirable, for example. These ingredients are excellent in transparency and have high dependability with the low dielectric constant comparatively.
[0132] As for the thickness of this interlayer insulation film 42, it is desirable that it is the range of about 1.5 to about 3.5 micrometers. About the minimum of this range, the level difference in the lower layer of an interlayer insulation film 42 is 200nm - hundreds of nm, and it is set up for the reasons of obtaining the surface smoothness of the top face of an interlayer insulation film 42, lowering the parasitic capacitance by the interlayer insulation film 42. Moreover, about the upper limit of the above-mentioned range, it is set up for the reasons of making reduction of the permeability of light into the minimum, controlling dispersion in the thickness of the liquid crystal layer 12 by the elastic deformation of an interlayer insulation film 42, holding down the cost of materials.
[0133] In the ingredient of the above-mentioned interlayer insulation film 42, if it is the ingredient with which the specific inductive capacity becomes about two to 4 between, the ingredient which fulfills the above-mentioned conditions can come to hand.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the outline configuration of the liquid crystal display component with which the liquid crystal display concerning one gestalt of operation of this invention is equipped.
[Drawing 2] It is the explanatory view showing the relation of the direction of rubbing of the orientation film and the viewing-angle direction in the above-mentioned liquid crystal display component.
[Drawing 3] It is the decomposition perspective view showing optical arrangement of the polarizing plate in the above-mentioned liquid crystal display, and a phase contrast plate.
[Drawing 4] It is the perspective view showing the principal indices of refraction in the phase contrast plate of the above-mentioned liquid crystal display.
[Drawing 5] It is the sectional view showing the configuration of the pixel substrate in the above-mentioned liquid crystal display, and its front face.
[Drawing 6] It is the sectional view showing the outline configuration of the above-mentioned liquid crystal display.
[Drawing 7] It is the explanatory view showing an example [counterelectrode / in the opposite substrate of the above-mentioned liquid crystal display component / the signal line and counterelectrode] of arrangement.
[Drawing 8] This drawing (a) thru/or (d) are the explanatory views showing the outline of the flow of orientation film formation down stream processing.
[Drawing 9] It is the perspective view showing the outline configuration of the liquid crystal display component with which the liquid crystal display concerning other gestalten of operation of this invention is equipped.
[Drawing 10] It is the sectional view showing the outline configuration of the above-mentioned liquid crystal display component.
[Drawing 11] It is the circuit diagram showing the configuration of the conventional transparency mold liquid crystal display equipped with the active-matrix substrate.
[Drawing 12] It is the sectional view showing the outline configuration of TFT of the active-matrix substrate in the conventional liquid crystal display.
[Drawing 13] It is the mimetic diagram showing the torsion orientation of the liquid crystal molecule in a TN liquid crystal display device.
[Drawing 14] It is the diagram which shows the angle-of-visibility property of the conventional liquid crystal display equipped with the active-matrix substrate.
[Drawing 15] It is the diagram which shows the angle-of-visibility property of other conventional liquid crystal displays equipped with the active-matrix substrate.
[Drawing 16] It is the perspective view showing the outline configuration of other conventional liquid crystal displays.
[Description of Notations]
1 Liquid Crystal Display

2a and 2b Phase contrast plate
3-4 Polarizing plate
5 Liquid Crystal Display Component
6 Opposite Substrate
7 Pixel Substrate
8 Signal Line
9-43 Pixel electrode
10-11 Orientation film
12 Liquid Crystal Layer
31 TFT
32 Scanning Line
38 Datum Line

[Translation done.]

* NOTICES *

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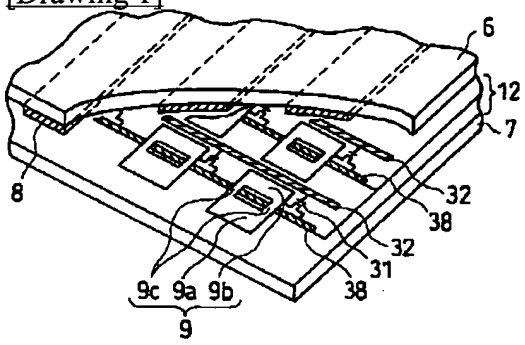
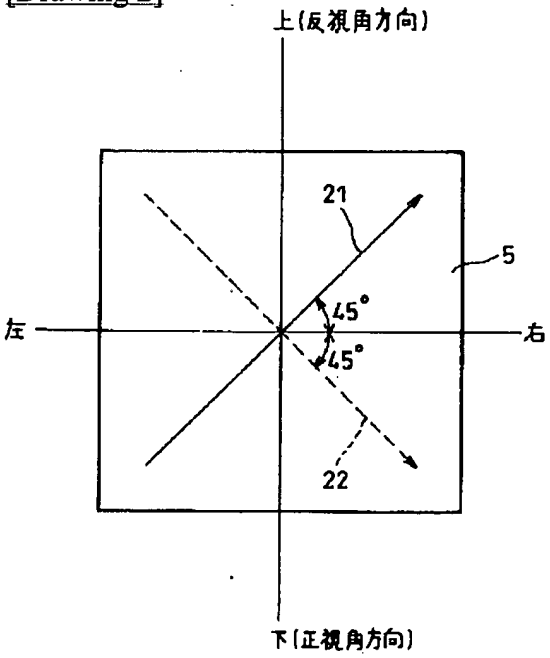
DRAWINGS

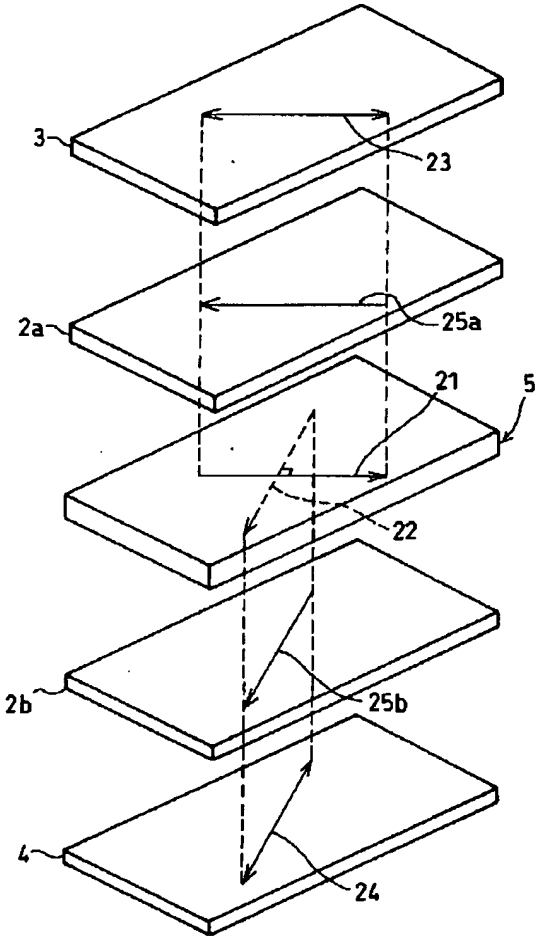
[Drawing 1]



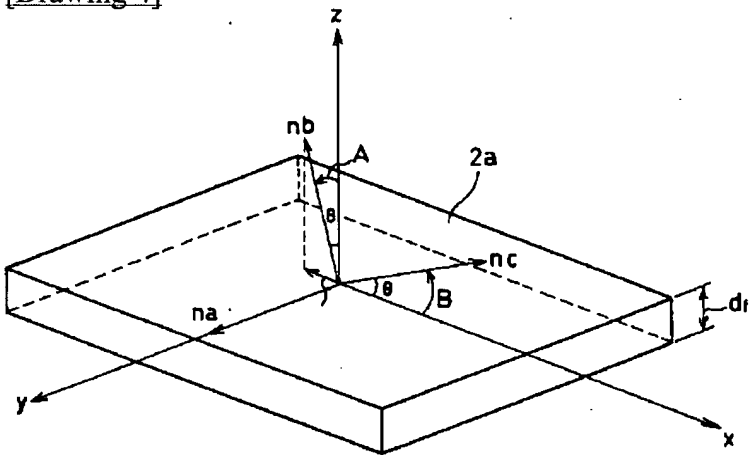
[Drawing 2]



[Drawing 3]



[Drawing 4]



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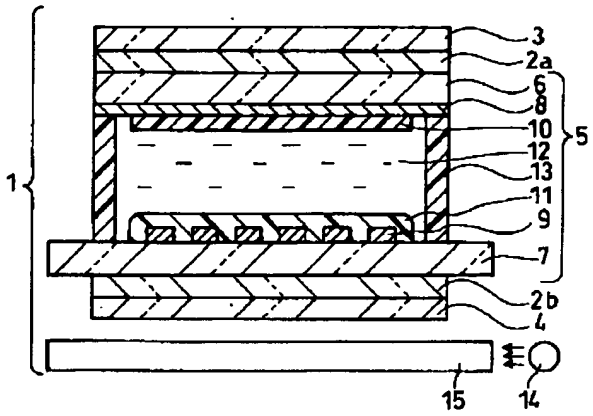
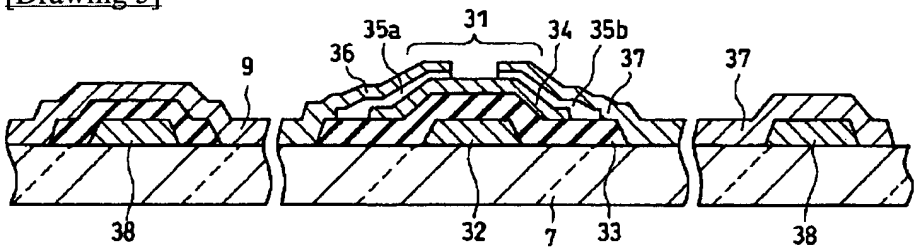
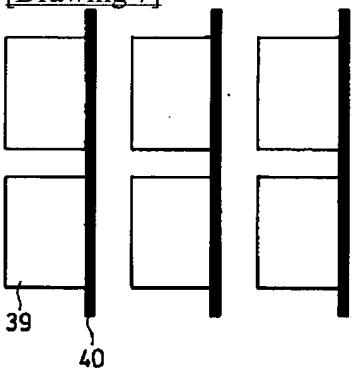


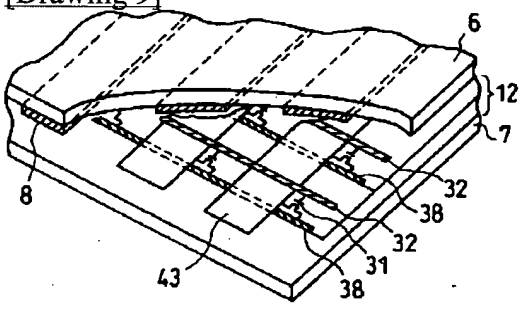
[Drawing 5]



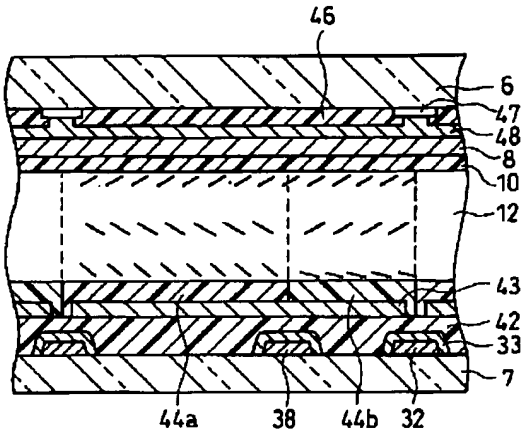
[Drawing 7]



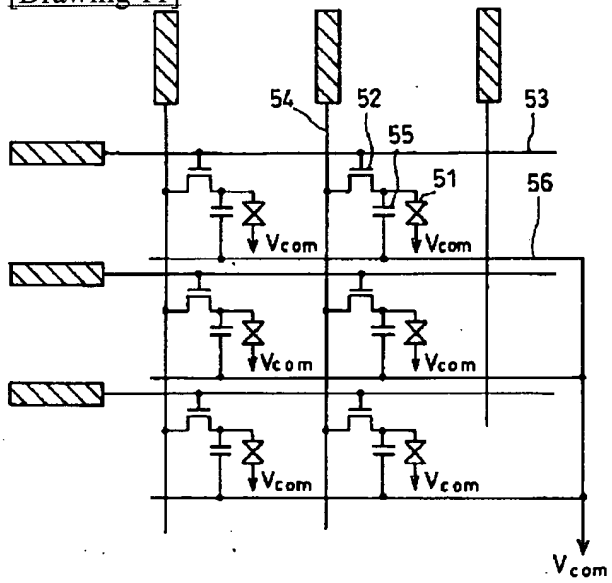
[Drawing 9]



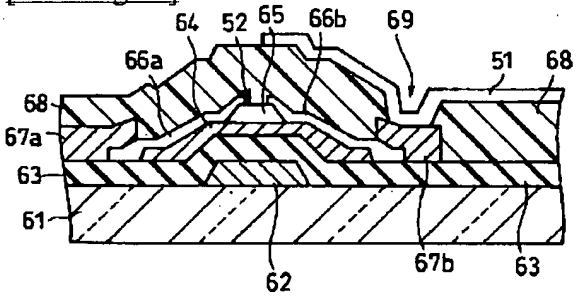
[Drawing 10]



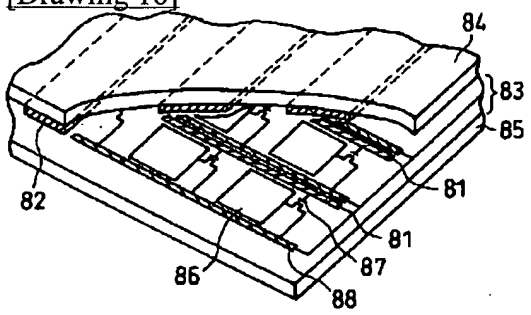
[Drawing 11]



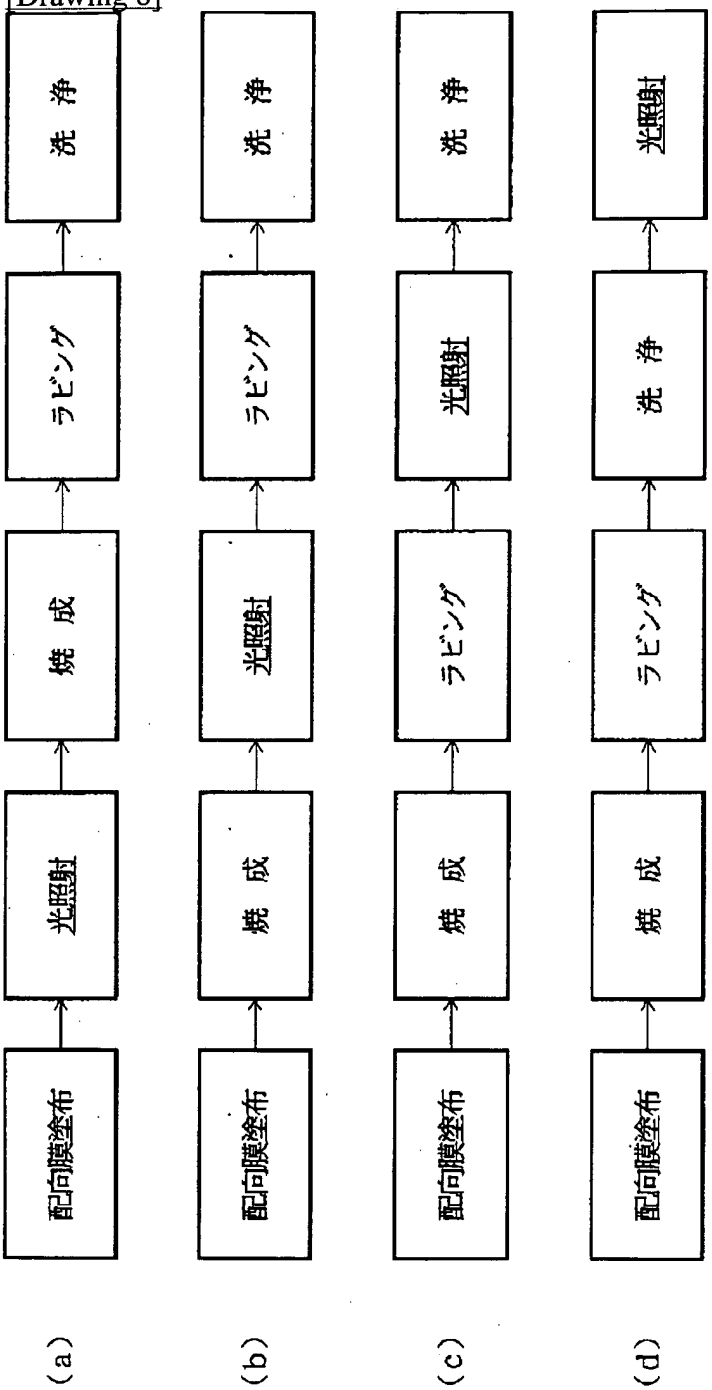
[Drawing 12]



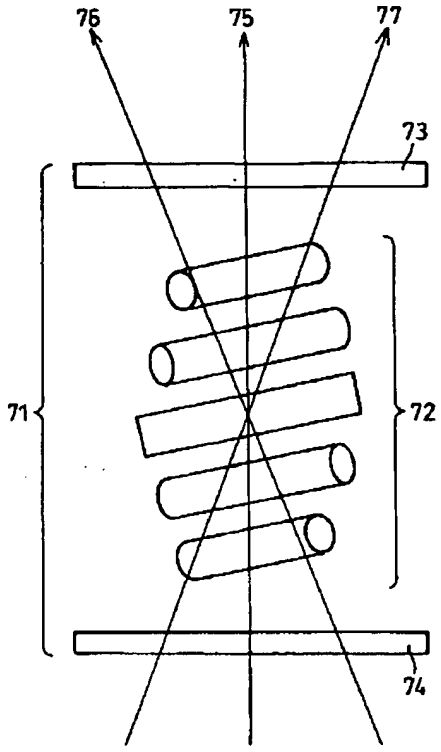
[Drawing 16]



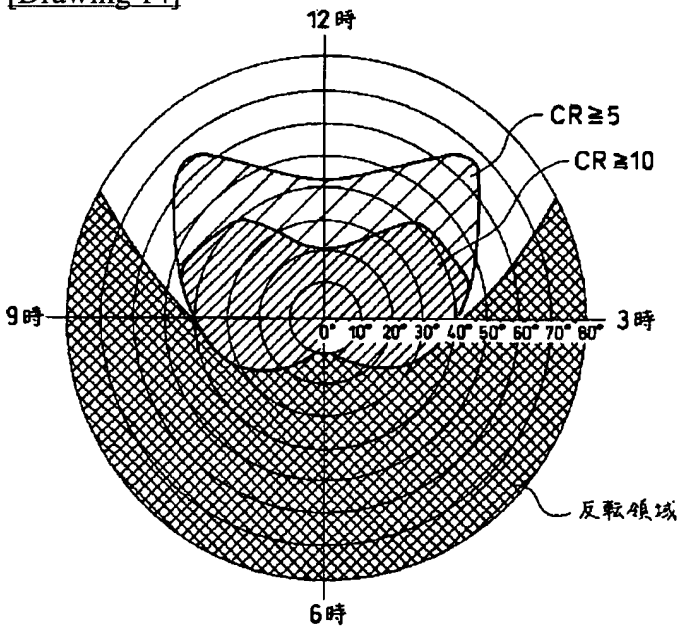
[Drawing 8]



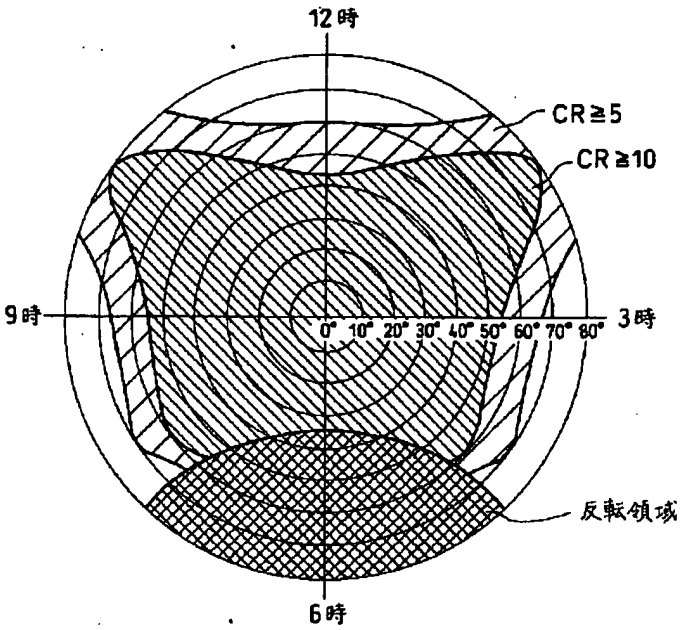
[Drawing 13]



[Drawing 14]



[Drawing 15]



[Translation done.]